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OF INDIA AND CEYLON.

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THE CULTIVATED ORANGES AND LEMONS ETC. OF INDIA AND CEYLON

WITH

RESEARCHES INTO THEIR ORIGIN AND THE DERIVATION OF THEIR NAMES, AND OTHER USEFUL INFORMATION

WITH AN ATLAS OF ILLUSTRATIONS

BY

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"I do not know whether you ever had the feeling of having thought so much over a subject that you had lost all power of judging it."

C. DARWIN to C. LYELL,
"Life and Letters," Vol. III., p. 72.

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PREFACE.

ALTHOUGH entitled "Oranges and Lemons," this work treats of *all* the varieties of Citrus.

I originally commenced it with a commercial object, that is, to show the numerous varieties of oranges, lemons, &c., now to be found in India, and their economic value. If not for export, at least there is room for an extended internal trade in these fruits, and for the development of certain industries from them in India. Besides the fresh fruit, the preserves made from it might be largely supplied in India instead of importing them. Then, essential oils and citric acid might, in due course, be also manufactured. The fact, however, was that the more researches I made, the more interesting the whole subject became, and as I found that not much of a satisfactory nature had been recorded regarding the cultivated citrus of India, I was tempted to extend my researches by asking friends to send me samples of citrus from various parts, which I had not any opportunity of visiting. I take this occasion to cordially thank all those who have helped me with specimens, drawings, books, and by their correspondence, and with statistics of trade in India connected with oranges and lemons. In the course of these investigations, one thing led to another, facts led to this and that speculation, and the present work, whatever may be its worth, has been the result.

With the exception of those courteously contributed by Mr. McLeod from Assam, and Mr. Stevenson from Sylhet, and those borrowed from other works, all the outline drawings in the accompanying Atlas were made by myself from the samples I obtained.

I need not say that the illustrations are very poor, and no doubt there is a certain amount of audacity in presenting such a collection of rough drawings to the public, when it is accustomed to highly-finished and artistic illustrations. The question, however, in this case, was not one between poverty and richness, but whether the illustrations were to be such as they are, or *none at all*. There are probably few who will not admit that an outline drawing, however rough, is better than nothing. It goes without saying that the drawings of the accompanying Atlas were not intended as works of art, but simply as a help to understand the text; and to intelligent persons, a rough outline of anything is often as good as the most elaborately-coloured picture, and far less expensive. Moreover, as I had the opportunity of seeing and handling a large number of forms of this most important genus to man (many of which are not known, and have never been seen out of the localities where they are grown), I thought it of some importance to preserve a record of them, however rough, for the benefit of any future student of this interesting genus. At this time of day it cannot any longer be said that *cultivated* forms of fruit are of no significance to botanists. There is, I believe, more science to be got out of cultivated forms of plants, than was once suspected.

The drawings were all made of natural size, but owing to the expense of getting them printed of that size, they had to be much reduced. I hope, however, that the scale of inches given in each plate will enable

the reader to form an idea of what the different kinds may be like.

The reader will understand that the grouping of these citrus, is in some cases rather arbitrary, for want of sufficient knowledge of the different varieties. This is the case especially with the lemon group. The smaller varieties resembling the limes proper would form an interesting study for anyone with leisure, and a garden in which he might grow them both from seed, and in other ways.

The chapter on morphology is entirely speculative, and may possibly be found of little value. In investigating anything, new ideas seem to be called up in one's mind beyond what is immediately visible. These have sometimes led to new standpoints for further investigations. It does not, however, follow that these new ideas always turn out true, or that it is wise to record them. In connection with these speculations about the citrus, I have entered upon some explanations, according to my views, on three allied genera—the Œgle, the Feronia, and the Limonia. Outlines of these will be found among the miscellaneous drawings at the end of the Atlas.

Some specimens arrived after I had arranged and numbered the plates; I have placed these at the end of each group. For similar reasons, and also because I don't know much about these varieties, I have placed Mr. McLeod's interesting drawings of Assam citrus, and those sent by Mr. Stevenson of Sylhet, all together in the miscellaneous part of the Atlas.

Some repetition has occurred in the various chapters, but this could not well have been avoided. I thought it preferable to repeat a few sentences here and there than to refer back the reader to what I said before.

The Appendix may be thought too big. In my

researches, however, I found a great deal that was interesting regarding the citrus, both from scientific and economic points of view. As this information was scattered in different books and journals, I thought that by putting it all in the Appendix it might be useful to some future investigator of the citrus family, and also to planters, &c. Moreover, in looking over the "Flora of Amboyna" of Rumphius, I found, as I thought, that his chapters on the citrus threw considerable light on the origin of some varieties of citrus now very common in India. I made a translation of these chapters for my own use. The more I looked into them the more interesting I found them, and as I am not aware that any translation of Rumphius's "Flora" has ever been made, I thought it might be useful to include these chapters in the Appendix. I trust the translations will be found sufficiently accurate for all practical purposes. I have in addition given tracings in the Atlas of all the citrus delineated by Rumphius, but as they are not made to any scale, it is often difficult to judge of their sizes. In describing them, however, he gave rough dimensions, which will help the better understanding of his drawings. For the opportunity of making these translations, I am indebted to Dr. G. King, the director of the Royal Botanic Garden at Seebpore, who very kindly lent me the copy of Rumphius in the botanical library. That copy has the additional advantage of having notes at the back of each plate, made by Hamilton Buchanan's own hand. The Appendix contains other information, which I trust may be found of some value.

The *notes*, wherever found, and not otherwise stated, are mine.

I have added a Glossary to help the general reader in understanding the terms which are not in common use.

In the Appendix, I have quoted figures, wherever I could find them, to show what is being done. Orange growers in India and Ceylon, with their command of cheap labour, might, I think, advantageously compete in the London markets with the growers of Florida and their dear labour. An English or American labourer is paid 5s. 3d. per day, and skilled gardeners get higher wages; that is, about ten times the wages of an Indian *mâli;* calculating that a good orange grower in India might probably be obtained for four annas a day, or eight rupees a month, or even less, if a commission were allowed him on the profits. It should be remembered that a sufficiently good orange grower, if he has the right soil, requires very little knowledge beyond that necessary for raising seedlings, budding them, and manuring and watering the trees at the proper times, all which he might learn in a month. If garden labour in India is ten times cheaper than that of Florida, it would require that the carriage from Florida to London should be ten times cheaper than that from Bombay and Karàchi to London, to enable the former to compete on equal terms with the latter. It will be seen, moreover, that in Florida, as stated in Appendix, No. 31, frosts are occasionally so severe as to turn all the orange crop into ice-balls, and ruin it, besides killing all the young stock in the nurseries, if it do not also injure the adult trees. There is, perhaps, no part of India, where oranges are grown extensively, which is subject to destructive frost, such as that which is said to have occurred in Florida in 1885-6.* Another object of some parts of the Appendix is not only to show planters in India what is being done in this line, *out* of

* Recently a book has been published called "Florida the Orange State."

India, and how important in many respects the citrus tree is, but also to warn them what to avoid, and how to turn this industry to the best account. As a rule, when an industry in India succeeds, and yields a fair profit, many rush in to spoil it by competition. Few ever attempt to strike out a new line for themselves. The *first one* who succeeds in any new line has usually an advantage, especially where trees require some time to come into full bearing, which it would be difficult for others afterwards to keep up with.

In the accompanying Atlas I have described as fully as I could all the specimens that came under my notice. I have given so many drawings of the same type, in order to show them from different climates and soils, as some kinds of citrus are much affected by changes in their surroundings. Moreover, I thought it would be of some value to leave records of any distinctions that may be made out by the senses of *one and the same* person, as the same colour, scent, and taste might be *differently* interpreted by *different* persons.

There may be some varieties which I may not have met with or heard of. If so, they must be left for some other investigator to discover and describe.*

As this work is intended mostly for India, I have entered fully on the cultivation of oranges and lemons in that country. This has made that chapter rather voluminous. I hope, however, that this may be a defect on the right side.

The list of dates in the Appendix might perhaps be considered unconnected with the subject of this work. But their aim is to elucidate the antiquity and fre-

* The observations on the leaves of young seedlings are fragmentary; but as I had so many varieties of them, I thought some record of them might be useful.

quency of trade with the places mentioned, and the opportunities there were of disseminating this useful tree. The remarks of Renaud are especially interesting, as they show that trade between Western Asia, India, the Malay Archipelago, and China, dates from the time of the Phoenicians, Greeks, and Romans.

There ought properly to have been added a chapter on the insects which are inimical to the citrus tree. Some of these may, however, be of use to it, although they feed on its leaves. Researches in Entomology, however important, would have made this volume interminable, and might have possibly put off its publication for ever.*

Wherever there is a want of fulness of description in the text, it may be found supplemented on the back of the plates of the Atlas.

In some plates I have not been able to give drawings of typical leaves. It is difficult in corresponding with persons in various parts of India to impress them with the necessity of sending typical leaves. I have, therefore, been often obliged to give only the outlines of those that came with the specimens. These leaves, however, have often, I think, a morphological interest of their own. By typical leaves I mean the fully developed ones of the adult tree or adult branch, and such as give the character to the tree. This defect in some of the plates will, however, be found generally supplemented by typical leaves of the same variety in other plates.

I have always thought that a good Index to a book is one of its most useful parts; and so I have endeavoured to make one as full as I could. Through the

* Recently an illustrated work has been published by the Italian Government, entitled "Studi sugli Agrumi," and the author is said to be Penzig.

Index, the information given in the Appendix will be easily got at.

In the Conclusions, I have mentioned what, according to my view, appear some of the more prominent results of this investigation.

INTRODUCTION.

What is the difference between an orange and a lemon? Various examples occur, which do not agree, either with the popular definition of oranges and lemons, or with that given by botanists. For instance the *khatta* citrus of India has an orange leaf, an orange exterior, an orange pulp, yet its fruit is prominently mammillate, and its flower is tinged purple. Again, the acidless citrus, the *mitha-nimboo,* has a lemon-yellow exterior, a white pulp, and it is mammillate; its leaves are like those of a lemon, yet its flowers are pure white. The *jhambìri* proper has orange-like leaves, the flowers are slightly tinged with purple, the pulp, varies from white to pale yellow, or orange, and the fruit is mammillate, and of two kinds externally, either of an orange colour, or of a lemon-yellow, and possibly also of a fawn colour.*

Then are these intermediate forms the result of natural crossing? Without having made direct and careful experiments, I cannot say whether the mingling of the orange and lemon, by crossing, is even *possible.* All my observations, and the records of others incline me to the conclusion that the different varieties of citrus do not readily cross. Plants raised from seed, however, are said to vary within certain limits, even without crossing. The Séville orange, the *khatta,*

* *Vide* pl. 259, for a still more curious apparent mixture of orange and citron in *one* fruit. (?)

orange, and the true lime have rarely, if ever, been raised in India in any other way than by seed, and from being grown together, and flowering at the same time, there must have been frequent opportunities for centuries, for natural crosses to have occurred, if these could easily happen; yet in no case, either in the leaf, the fruit, the flower, or in the general habit of the tree, have I noticed the slightest suspicion of disturbance, which could be attributed to crossing.

It will be seen that there are two distinct types of *sweet* oranges, viz., the close skinned Portugal orange, and the loose-skinned *sŭntără* orange of India.* Their trees are quite distinct. The former appears of comparatively recent introduction in India, while the latter must have existed from a very remote period, on the Eastern Border. In Emperor Baber's time it was hardly known in the plains of India, and even in Roxburgh's time it appears to have made very little progress. Now, however, it is found under various forms, all over India and Ceylon. In the time of Rumphius it was well known in the Malay Archipelago, under the name of *China* orange. Although from its prevalence on the Eastern hills in a semi-wild state, it might be thought indigenous in India, all my researches point to its being of foreign origin, either directly from Cochin China, across the Eastern border, or by way of the Malay Archipelago; although now, and for a very long time back, it has become naturalized. Some future student of the Indo-Chinese languages, and ancient writings, may perhaps succeed in throwing new light on this point.†

* It may be possibly found that its proper designation was originally *seng-tara*.

† *Vide* Appendix, No. 41 (*m*), regarding the Chinese names of oranges, *Bit-cam* and *Seng-cam*.

All citrus will change features to some extent, by change of climate, soil, and culture, and if grown from seed, under changed circumstances, probably further changes might be obtained by selection. The smoothness or wartiness, the thinness or thickness of skin, the sweetness or sourness, the dryness or juiciness, and the size of the fruit are particularly liable to change, and therefore all the characters of the tree, flower, fruit, and seed, should be considered, in grouping the various forms of citrus. In my researches I have met with no evidence tending to show that any of the sweet oranges are direct descendants of the bitter, or Séville orange.

At the end of the lemon group, I have delineated specimens of double lemons. I have given these because I believe that this doubling of the citrus fruit, that is the fusion of two ovaries, and not the addition of carpels in the same ovary, has played a considerable part in the production of the *large* kinds of citrus. First these double citrus may have attracted attention, as curious novelties, and then by repetition and selection through the seed, a more perfect, and large variety may have been established. These twin fruits are moreover interesting on account of their connection with the game of "Philippine," which the natives of India call *Faramòsh* (*vide* Appendix, No. 21).

Fortunately, I have been able to examine a large number of citrus with "my own" eyes, olfactory and gustatory nerves, which circumstances, I think, have great advantages. Probably no two persons would see things in the same way, or detect the same shades of taste and scent. It is by these means that I have been able to make out varieties of the same groups, such as the Séville and Portugal oranges.

The balance of evidence at present obtainable is not, I think, in favour of the true lime being a variety of the Citrus medica proper.

There are many varieties of citrus in India, that might without much difficulty, be referred to the C. medica; but in the Malay Archipelago, in the time of Rumphius, there was a whole group of cultivated citrus, referable with more probability to the citrus hystrix, which is said to be found in a wild state in Burma, not improbably the true lime may belong to this group. The facilities for its being transported to India at some remote period appear to have been great. I believe that the Malay Archipelago, with its numerous islands, its temperature and moisture, has played an important part in giving birth to new varieties of citrus. I further believe that those numerous islands have acted as a sort of half-way house for the dissemination of the Chinese varieties of citrus to India, Africa, Western Asia, and Europe. At each place, new varieties resulted from the sowing of the seed, under different conditions of climate, soil, &c.

In the following chapters I have entered fully into all that concerns each group of citrus. That on the Pummelo may be found interesting to Botanists, as hitherto they have considered it a separate species. For reasons given, I do not think it so.

It is, I think, of some importance to have established by these researches that one of the best pummelos in the world, is to be found in Bombay in December — a red, thin-skinned juicy fruit, as large as a man's head; that Tanjore possesses the best Portugal orange in all India; that Butwal on the borders of Nepal, north of Gorruckpore and Gonda, grows in a semi-wild state, perhaps the sweetest orange to be had in any part of the world; that Gujranwàla in the

Punjab can grow a blood orange, equal to, if not superior to, that of Malta. That Delhi can grow in the shade of trees, one of the finest oranges to be found in India; that Almora possesses a citron from which a candied peel can be made superior to that of Leghorn; that the Malta, Portugal or Sicilian lemon, identical with that of the English shops, can be grown all over India, from the Himalayas to Cape Comorin, and Ceylon, and that sliced and boiled in a certain way, it is a very efficient remedy for intermittent fever and enlarged spleen, the two real and always present plagues of the rural population of Hindostan.

Many of these important points were not known before, beyond the immediate neighbourhood where the different kinds were grown. This work gives in detail, not only the history of the citrus in India, as far as it can be made out, and its mode of cultivation in different places, but also outline drawings of every variety of orange, lemon, citron, lime, pummelo, &c., to be found in India, with the places at which they can be procured.

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ORANGES AND LEMONS OF INDIA.

CHAPTER I.

THE SÉVILLE ORANGES.

THE Emperor Baber, in his memoirs, mentions the "nâranj" as one of the kinds of Citrus he found in India. I don't, however, believe that he meant by this name the bitter or Séville orange.* He says little about the Indian oranges, but a good deal about those of Central Asia, and the N.W. frontier of India. He adds that in the latter part it is called *nârank*. The kinds he alludes to are evidently *sweet* oranges of some sort (vide Baber's memoirs, Appendix No. 1 (*a*)).

It is more probable that his *kirneh*† is the Séville orange. He says it is *acid*. There is, however, much confusion in Indian names of Citrus. *Karna* is one of the names given to a true Séville, on the western coast. While another totally different kind —the *khattà* of most places—is, by some, also called *karna*. I am informed that the latter name in Sanskrit means "bitter."

Risso, in his monograph, gives "nârandj" as the Arabic Synonym of the Citrus Bigaradia, the Séville orange, and Alphonse de Candolle credits the Arabs

* Although Risso gives *nârandj* as synonymous with Séville orange.

† Appendix, No. 1 (*i*).

with having transported the bitter orange from Western India to Persia, Arabia, Syria, Northern Africa, and Spain. The Arab physicians are known to have used it in their pharmaceutical preparations. The Arab name *nâranj* may or may not have been derived from *nagrung*, the *supposed* Sanskrit name for orange.

Sir J. Hooker, following Brandis, places the bitter or Séville orange, as *Var.* 2, *Bigaradia*, of Citrus aurantium, Linn., and says "petiole usually winged, flowers larger, and more strongly scented (than those of the sweet orange), rind very aromatic, pulp bitter." And the original of which this is supposed to be only a variety, he considers is C. aurantium, Linn. "Arboreus, rarely shrubby, young shoots glabrous, greenish white, leaflet elliptic or ovate, acute, obtuse or acuminate ; petiole often broadly winged, flowers pure white, bisexual, fruit globose, generally oblate, not mammillate." He adds that the wild Citrus aurantium is found in the "Lob valleys, along the foot of the Himalaya, from Garwhal eastwards to Sikkim, and in the Khasia Mountains—a small slender tree, flowering in the rains and fruiting after them, growing where I found it, in the very bottoms of valleys, and where it did not occur to me to doubt its being indigenous. The fruit was somewhat flattened, or nearly globose, about two in. diam., high-coloured, and uneatable, being (if I remember aright) mawkish and bitter."

It is not improbable, in my opinion, that the description given above of the wild species belongs to *one section only* of the orange tribe, viz., those which are now semi-cultivated—semi-wild—in various places along the foot of the Himalayas. They appear to belong to the *sùntara* and *kamalà* section. All these have "a slender tree." As to their flowering in the rains, almost *all* the Citrus flower twice ; some flower

all the year round. The main crop of flowers comes out in February or March, which corresponds to the Indian spring. The fruit of this crop ripens about December. The second and much smaller crop of flowers comes out in the rains with the rain-foliage. The fruit of these, which natives call *Dumrêz,* ripens in the ensuing April or thereabouts.

I must here first observe that, in my opinion, a great deal of confusion has arisen in describing oranges, by grouping all the sweet ones under the *one* name of *sweet oranges.* It appears to me that the so-called sweet oranges are *distinctly* divisible into *two* great sections, one, the *Malta or Portugal orange*—the Citrus aurantium sinense of *Gallesio,* and its varieties ; and the other, the *sùntara orange of India,* the Citrus aurantium sinense of *Rumphius* and its derivatives. The former is a *close* skinned orange, with a distinct tree, not at all slender, and with a distinct, not very aromatic leaf. The latter is a *loose* skinned orange, often *baggy.* Its tree is also distinct and *slender,* with a *distinct* aroma in its leaves. Neither of them is *totally* sweet. When unripe they are sour, and as they ripen the acid changes into sugar, and their charm, even when ripe, is to possess in their pulp a pleasant *mixture* of sweet and sub-acid flavour. The only true sweet orange I know is a variety of the Malta orange, which has an *acidless* pulp from *beginning to end,* like the sweet lemons of India. I have never seen this acidless orange in India. Another source of some confusion comes from calling the Séville orange *bitter.* I have tasted the pulp of many Sévilles in various parts, and rarely have I found the pulp bitter. It is simply *sour.* Sometimes I thought the pulp had a " soupçon " of bitterness in it, but very rarely. I think the mistake,

if it be a mistake, has arisen from the *way* of *tasting* the pulp. If you cut a Séville orange in two transversely, and then give the pulp a bite, you will probably say it is *bitter* But in biting the pulp with the upper teeth, your lower teeth and lip graze against the rind, which is intensely bitter, aromatic and pungent. The bitterness of the rind mixing with the juice in the mouth makes you think the pulp is *bitter-sour.* While if you use a spoon and scoop out a bit of the pulp without touching the rind and taste it, you will probably say it is only *sour.**

Wherever I have met with the Séville orange, whether smooth or subwarty, whether large or small, whether in Upper India, Southern India, or Ceylon, it had the same character : rind very aromatic, bitter and pungent ; pulp sour (in some cases I thought it *slightly* bitter) ; leaves of a deep green, *always* typically with a winged petiole, oftener with *large* wings to their petioles, and *always* with a distinct, and what I consider a *characteristic*, strong and *very pleasant* aroma in its leaves. It is on account of this aroma in the leaves that by preference in Europe they are distilled for their essential oil, which perfumers call " petit-grain." I have examined Sévilles from Malta, from Lucknow, from Gonda, from Etawah (the latter said to have been got from the Punjạb), from Mooltan, from Calcutta, from Kandy, and Newra Ellia in Ceylon ; all with that characteristic scent in the leaf, and all have the same charactered fruit—viz., bitter, aromatic and pungent rind and sour pulp. The two combined make the best marmalade. Wherever I had an opportunity of examining the flowers they were highly scented. It is difficult, owing to the above sources of

* Possibly the *envelopes* of the quarters, or carpels, in which the juice vesicles are contained, may sometimes be bitter.

confusion, to satisfy oneself regarding the wild parent of the cultivated Séville orange. De Candolle says that the Citrus fusca of Loureiro, is wild in China and Cochin China. Loureiro says that his C. fusca corresponds with the Aurantium *acidum* of Rumphius, given in plate 33 (not 23 as is stated in De Candolle's book ;* the latter is a Tamarind), Vol. II. Flor. Amboyn. The figure on that plate is certainly, both in leaf, spine, and fruit like the small Séville I saw in Newra Ellia. But curiously enough, Loureiro says "the leaves have an *unpleasant* odor, and the flowers are *not* very scented" (sub-odorous). In other respects his description corresponds exactly to that of the Sévilles I have seen. With regard to the scent of the leaves and flowers, without laying much stress on this character, I would observe, that some people see green, that which is red ; and others cannot hear certain sounds. It is therefore likely that the olfactory nerves of all of us do not recognize the same shades of odor, so that it is not impossible Loureiro's olfactory nerves were differently impressed by aromas, which others might call *distinctly* and strongly *sweet*. It is not impossible also, that a wild plant might be differently scented from a cultivated one. It is, however, rather strange that the leaves of *all* the Sévilles I have seen should retain so persistently and *exactly* the *same* fine aroma in their leaves. None of them could be called *cultivated*, but rather, *not wild*. Only one — the *nârtun* of Tanjore, which I think is a Séville—had an unpleasant resinous scent in its leaves. Nevertheless, the young seedling of this same *nârtun* had in its young leaves the characteristic aroma of all the others I had met with. The flowers of the *nârtun* I have not seen. Not improbably

* Origin of Cultivated Plants—English translation.

Loureiro's C. fusca may have been like the *nârtun* of Tanjore.

The Séville orange, or the Citrus bigaradia of Risso, the "Bigaradier franc" of the French, the "Arancio forte" of the Italians, and the *nâranj* of the old Arab physicians, is probably not an *Indian* Citrus, but originally a Chinese variety, and probably one of the most ancient varieties of Citrus. Being used medicinally, it may have reached Western India (possibly across South India) before any other kind of Citrus, and was adopted by the Arab physicians in their pharmacopœia. As alcohol is also an old Arab production, it is not impossible that those ancient physicians extracted whatever there is of active principle in the *nâranj* peel, by means of alcohol, which was afterwards handed down to us as "tincture of orange peel," and is now principally used for disguising the unpleasant flavours of other medicines.

It is not easy to make out whether Sir J. Hooker's wild orange of the Himalayas is this, or some sour variety of the *sùntara* type. I incline to the latter view, especially as the *sùntara* type of orange is so common all along the outer hills of the north-eastern Himalayas. That the Séville is found wild in Cochin China is pretty clear from the researches of Loureiro, where he calls it "citrus fusca," which in turn corresponds with Rumphius's *aurantium acidum* of Amboyna, which again Miquel asserts is the same as citrus vulgaris of Risso—the Séville orange. Being a medicinal plant, it is not impossible that from South-Eastern Asia it may have found its way to Eastern India through the Malay archipelago, and thence across South India to the Western Coast, whence it was in course of time taken to Europe, *via* Syria. The only place in India where I have heard of its being now

wild is in the forests near "Devikulam" in Southern India, from which wild trees Mr. John Payne sent me some leaves. In my opinion these are unmistakably of the Séville variety; but whether this is indigenous in South India, or has become naturalized there, it is impossible to say. I have been told that in the Nilghiris there is a place called the "Orange Vale," where some kind of wild orange grows, but what this is I don't know. I tried to obtain information about the "Orange Vale" trees, but have not succeeded. There does not appear to be any indigenous Citrus in Ceylon, although the Séville orange is well known and grown there in many places under the name of *Amool Dòdan.*

In Europe the Séville orange stands the cold better than other kinds, and that may be the reason why the Italians have given it the qualifying name of "forte.' In Florence I have seen it growing in the open, under a south wall, while the Portugal or Malta oranges cannot be grown at all there without artificial heat, and all the lemon trees grown there are protected under roofs in winter.

Another reason why I do not think the Séville orange an Indian Citrus is that it has many names, most of them being names of *other* kinds of Citrus. In Lucknow it is called *nâranj;* in Gonda, *sadàphal;* in Mooltan, *khattà*, which simply means *sour;* in Calcutta, *goralemboo*, or *common* Citrus; in Mangalore and Mysore, *karna*, or *kanchikai;* in Ceylon, *amool dòdan* which means *sour and round.*

In my opinion it is hardly possible that this Séville orange, or so-called *bitter* orange, could have been the direct progenitor of one of the sweet oranges, the Malta or Portugal orange, the *Citrus aurantium sinense* of Gallesio. Had it been so, it would be hardlypossible

that the distinctive aroma of the Séville leaf should not, at some subsequent period, reappear in some of its sweet descendant varieties. I have seen several varieties of the Malta or Portugal orange in India, and never have I met with the Séville scent in their leaves. This need not, however, trouble us much. Man, who is supposed to have originated from some animal with an *external* tail, never now reproduces that character except in embryo. The *internal* tail in the fully formed man has become so fixed a character that no reversions are ever met with. In the same way we never see the horse reverting to his three-toed progenitor. I may, however, briefly state why I don't think, as botanists do, that the bitter orange is the direct progenitor of the sweet Malta or Portugal orange (C. aurantium sinense).

(*a.*) Gallesio, during an experience of 60 years, found that on no occasion did seedlings of the Malta orange ever revert to the Séville.

(*b.*) The counter-statement of Macfadyen that it does sometimes revert, is tainted with the suspicion that sufficiently accurate records were impossible in the West Indies, where negroes were concerned (if negroes were then the gardeners). Even in India, where natives are supposed to be more intelligent than negroes, the people can never be relied on for *accuracy in anything.*

(*c.*) Wherever I have seen the Séville orange it has always had a bitter pungent rind, sour pulp, and a highly scented leaf, with a *very distinct* aroma ; and wherever I have seen the Maltaor Portugal orange (and of this type there are many varieties in India) it has always had a characteristic scent, a sour-sweet pulp, and a totally different and weak scent in its leaves. Never have I found in the leaves of the Malta orange

type anything approaching the scent of the Séville leaf. Had these two been related, as mother and daughter, it is hardly possible that the latter would never have reproduced *some* of the characters of the former. The two have nothing in common except a close skin, orange colour, white flower, and the general characters of the *genus*.

(*d.*) The Séville has been grown for ages from *seed*. Probably it has never, or very rarely, been propagated in any other way. If it *once* produced a *sweet* orange, is it likely that this phenomenon would never have been produced a *second* time. Both Gallesio and Macfadyen state that they never knew an instance of the Séville seed producing a Portugal orange. Therefore I am inclined to think that these two oranges are no more related to each other than both are related to the *Sùntara* orange, which also has a red skin and a white flower. They are not improbably two distinct branches of some common and much more ancient stock. I should, moreover, not wonder if direct experiment were to prove that they are not even *miscible* by hybridization. Although the two have been grown side by side for centuries I can find no evidence that they ever crossed and produced intermediate forms. All the varieties of each, which I have seen, form as distinct groups as those of any two species.*

In the "Atlas" drawings of the Séville oranges are given from pl. 1 to pl. 18.

* The following appears to confirm my conclusion, arrived at from observation. In the "Bot. Mag.," iii., 6807, under the heading of *Bijou Lime*, it is stated that "Mr. Rivers finds that the bitter orange will not hybridize with the sweet, nor the limes and lemons with the orange. . . . On the other hand, Darwin (Cross- and Self-Fertilizing of Plants, p. 394) says that he has collected evidence on the natural crossing of varieties of the orange, and cites the authority of Gallesio for the fact."

CHAPTER II.

THE "KHATTÀ" OR "KARNA" ORANGES.

THE Emperor Baber, in his memoirs, just mentions the *kirneh*, and all he says, is that it is "tart, and may be about the size of a *gulgul* lime." *

It is impossible from this mention to make out whether Baber's *Kirneh*, is the same as the *Khattà* or *karna* of moderns. In Mangalore, what they call *karna* is a *Séville* orange, and I have been told, that in Mysore the *karna* is the same as the Mangalore one. The *khattà* or *karna* of Upper India is totally different from the Séville orange. It is not improbable that Baber's *kirneh* is the orange in question. If so, he makes no mention of the Séville orange, and the latter appears to be the oldest known in Western India, as it is stated it was from *there* that the Arabs introduced it into Syria, and the Mediterranean. This however may not be accurate, as the Arabs traded also with the Malay archipelago, and with China, whence the Arabs may have got it. The translators of Baber's memoirs under the heading of *nâranj*, say "or Séville orange." This, however, is only the translators' notion, for surely Baber could not have said of the *Séville* orange, that in Lemghanât, Bajour, and Siwâd, "it was both plentiful and good," considering that its popular name is the "bitter orange," and its pulp is very sour. Then Baber also states that "the size of

* Vide Appendix, No. 1 (*i*).

the oranges of Bajour may be about that of the quince, and their juice is more acid than that of other oranges."* He evidently could not have been describing by these a *thoroughly sour orange*, but a sweetish one, and that it was not *so sweet* as others he knew. He then ends by saying that "the men of Bajour and Síwâd call *nâranj*, *nârank*," and the translators go on to say, "or perhaps rather *nârang*."† Unless Baber has mixed up the sweet with the bitter orange, it is hardly possible that by *nâranj* (which is given by Risso as the Arabic synomyn of the Séville orange) he meant any other than some *sweet* kind of orange. If so, he has left out the Séville orange altogether, unless he has mixed it up with the *khattà* or *karna* of moderns.

There are other names which natives give the common *khattà*. One *mali* told me that the *khattà* is the *gulgul*. Another said that *men* call it *khattà*, and *women gulgul*, and that in Cawnpore it goes indifferently, by the name of either *gulgul* or *khattà*. From Jubbulpore it came under the name of *attàrra*, lime, and others have called it common sour lime. Major Buller kindly sent me a number of specimens of the *khattà* orange from the Gonda district, from some of the gardens of the late Maharaja of Bulrampur. Two were somewhat warty, and were called *pahàree chakôtra*, or hill Pummelo! Other smooth varieties were ticketed *urna nimboo*, *bijòra nimboo*, *turunj nimboo*, *kàrna nimboo*, and *chakôtra tursh*, or sour Pummelo! It is hardly possible that the *malis* did not know that these were all one and the same thing.

* Vide Appendix, No. 1 (*a*).

† This is an indication that in the Jaghatai Turki there is no *g* hard as in the Persian, and that, as I said in another place, the translators' *kilkil* probably means nothing but *gulgul*.

With the exception of *karna nimboo*, I think all these names must have been inventions of the people about the late Maharaja, who may have deceived him with these new varieties, in order to get *bakshish* out of him, probably under the persuasion that they were sweeping the country for novelties for him. All those mentioned above, including the warty ones might, however, have been taken *off one tree*.

This *khattà* orange is not alluded to in any botanical book that I have seen, and Alph. de Candolle in his "Origin of Cultivated Plants" apparently had not even suspected its existence; yet it is a *very distinct* sour orange, and very common, and must not in any way be confounded either with the Séville orange, or with the citron as some people sometimes call it, including probably the translators of Baber's memoirs.

Wherever I have seen this *khattà* orange, it has had always the same characters. Probably it has never been raised in any other way than from seed, as no one would think it worth the trouble of budding, or grafting it on other stock. It is largely raised from seeds, and used for budding other better kinds on, as the seed germinates freely, and the young plants make rapid and vigorous growth. In order to prevent any further mistakes about it, I shall endeavour to give as minute a description of its botanical characters as I can.

It is a strong growing tree, not at all slender, spinous, sometimes its spines are formidable. The typical leaves are dark green and ovate, rather serrate than crenate, from three to four inches long, but larger and smaller are also found. Its very young shoots and leaves are pale green, only *tinged* with ochre-colour. This is much more pronounced in young seedling plants over a year old. The petiole is slender

and usually only margined; the leaves have scarcely any scent. The flowers are large, usually five-petalled, tinged red externally, like those of the lemon; otherwise, as in other oranges. The scent of the flowers is weak. The fruit is of two forms; either smooth, and only just rough to the touch, or *very* warty, as seen in pls. 27, 28, and 29. It is mostly mammillate, with furrows round the mammilla, leading to its point. Sometimes the mammilla is pronounced, at others it is flattened; and some rather rare specimens are oblate, as in pl. 20.

The smooth forms belong to the regular crop, the flowers of which come out in February and March, and develop in the *hottest and driest* weather; while the warty forms belong usually to the *Dumrêz*, or after-crop, the flowers of which come out in the rains, and develop during the *hottest and moistest* weather. Pls. 27, 28, and 29, show to what extent the two forms differ. I took the two specimens of pl. 29 off the *same* branch, and Major Buller got the two specimens of pl. 27 off the same tree, and said "it would hardly be believed that both came off the same tree." That in pl. 28 was the first I got from Khoorja. It came under the name of *khattà;* it was unripe, and very warty, and as it came alone, I did not know what to make of it, until I saw the two forms growing on the same branch in Benares.

It is not impossible that these two forms, *so distinct*, occurring on the same tree may help to throw some light on the *bizzarria*, and so-called *trifacial* oranges, although, in these, *distinct* parts occur in the *same* fruit. There is no reason to suppose that the two forms of this *khattà* orange have anything to do with hybridism. They belong to two *different* crops of the same tree, and appear to be caused by *external*

conditions, or the environment of the *two distinct seasons* of Northern India. As I said the flowers of form *a*, pl. 27, come out in March, and their fruit develops in the hottest and *driest* part of the year. They are the *main* crop of the tree. While the flowers of form *b* come out in June, when the rains commence, and their fruit develops in the hottest and *moistest* part of the year. They are the second, or *Dumrêz* crop of the tree.

All citrus trees in India give a second crop when the commencement of the rainy season gives a fresh start of vigour to the trees, and the two crops differ in form and characters more or less; but I have never noticed such a difference as is shown in the case of the *khattà*. Whether form *b* could be perpetuated and fixed by selection is more than I can say. (*Vide* Appendix, No. 65.)

If, therefore, a simple change of season with change of hygrometric conditions of the atmosphere and soil (as well as any possible change of electric influence) is capable of producing such very distinct forms of citrus in the *same* tree, and in the *same* locality, one can without much difficulty, conceive that a total change of climate, soil, and environment, might effect still greater changes, without any influence from hybridism, and without the necessity of origin from a distinct species. For instance, if a variety of citrus *raised* from seed in South Europe were transported to the islands of the Malay archipelago, or to the *Tarai* at the foot of the Himalayas in India, and there further generations raised from its seeds (the latter inevitably partaking of the effects of any influences caused by change of climate and soil) one can readily imagine that great variations would be possible. These then might be eventually perpetuated, and fixed by selection

through human agency, or otherwise. I think we are ignorant of what initiates changes in the most important part of a tree, viz., the seed. A seedless egg-orange plant transported from Malta to Lucknow gave oranges which were crammed with seed!

The *gulgul* of Jubbulpore, pl. 31, appears to belong to the *khattà* orange group, but whether it is only a *Dumrêz* form, or that of the regular crop, I do not know. The *gulgul* of Lahore, a formidable citrus, pl. 32, belongs I think also to the *khattà* group, and so do two still more formidable ones, sent by Major Buller from the Maharaja of Bulrampur's gardens, on the Nepal border, under the name of *kuthatree nimboo* (or *jack* nimboo), and *rus kankur* (or *juicy* kankur), pl. 35.

One had a girth of 22¾ in. and another, too big to be pictured, from Toolshepur, with a girth of 24 inches, a length of 10 inches, and a diameter of 7½ inches. It is the largest Citrus, excepting a pummelo, which I have yet seen. These large warty *khattàs* have the same curious mammilla—semi-pronounced or semi-flattened as that of pl. 29.

In the smooth form the ripe *khattà* orange is softish and elastic, and soon becomes flabby by keeping. When ripe the exterior is of a delicate maize-orange, with a thick skin, sometimes *very* thick; the pithy part of which is white, and very spongy. The pulp is either orange or pale yellow-orange, and very sour, without any bitterness, hence its name *khattà*. The warty forms are of the same colour when ripe, and pale green when unripe. Their warts are very prominent. The huge kinds, shown in plates 32 and 35, and which I consider a sub-variety of the common *khattà*, have a lumpy surface, like round nodules of *kunkur*, with the oil cells large and very distinct. They have a lumpy pro-

nounced mammilla. The skin of the largest is upwards of an inch thick. The pithy part is white, very soft and spongy, and the pulp of those from Lahore and Gonda is white, with an imaginary tinge of very indistinct pale orange, while the pulp of that from Jubbulpore, pl. 31, is pale orange-yellow. The seeds in all are white, when cut, and the largest was seedless. Major Buller says that the thick skin of the *kathairee nimboo* is the only part which is eaten, the white part being sweet.

These citron-like fruits might, from a superficial examination, be pronounced Citrons proper, but their foliage is orange-like, and the pithy part of the skin spongy, like that of the pummelo, while the same part of all true Citrons is hard and of a dense carroty consistence. The *khattà* Citrus is very distinct, and cannot come under any of the other groups. In its foliage, colour of rind, consistence of skin, and colour of pulp, *it is* an orange; in its flower and mammilla it is a lemon or citron. Botanists say that the flower of the true citron and its descendant, the lemon, are tinged purple, and the fruit is mammillate, while the flowers of the orange are pure white, and the fruit is generally oblate. In the Benares garden I saw a true citron tree, with citron foliage and *pure white flowers;* and I have seen an oblate specimen of a *khattà* fruit. Most of the *keonla* and *naringhi* oranges have a *flattened mammilla.* The *jhambiri*, a kind of Citrus, has one variety with a yellow exterior like a lemon, and another with a red exterior like an orange; otherwise they are indistinguishable. The *khattà* has had time enough to sport and revert, having been, from time immemorial, raised from seed, and it must have had infinite chances of becoming crossed with other Citrus; yet its characters are very constant, and, with the excep-

tion of wartiness and size, which belong to the same tree, I have not noticed any other variation, although it is the commonest Citrus, and of which I have seen innumerable specimens.

It must be left to some future student of this interesting Citrus to decide whether it is an orange or a lemon. As the majority of its characters are those of an orange I would propose to call it Citrus aurantium, var. *khattà*. It would appear, however, that there is not much difference between the orange and the lemon, botanically speaking. We know how easily a white flower is born of other coloured flowers in crossing. In the morphological development of the Citrus the yellow variety probably was anterior to the orange variety, both tints being probably no other than those which many leaves take in withering, or ripening, viz., the yellow first and the orange or red later on. What is more practical, however, and perhaps more important, is this : I am informed that this *khattà* orange makes a good sweet jelly, and also a good marmalade. I know the decoction of its fruit is a good febrifuge, and also a good splenifuge. It is well known also that it makes a good and vigorous stock for budding other kinds of Citrus on, whether it makes a very durable one I do not know ; and there is some suspicion that it is not the *best* stock for budding the *sweet* varieties of Citrus on.

I have seen many specimens of this Citrus from various places, but as they all had the same character, differing only in size, I did not think it necessary to multiply the drawings any further.

What exactly causes the extreme wartiness of the *Dumrêz* form I do not know, nor do I know whether all *khattà* trees produce this warty form. It is quite evident, however, that wartiness and smoothness

cannot be taken as *specific* characters, since the two *opposites* can be produced on the *same tree.* It is not improbable that two very distinct races of *khattà* might be raised by selecting the seeds of only the one variety, and keeping the trees separate. This might be readily ascertained within five or six years in any of the horticultural gardens of India.

Unless seen on the tree, it would hardly be believed that these two forms can be produced on the *same tree.* It only shows how careful one must be not to take a single character as indicating a specific distinction, and how necessary it is to see the fruit on the tree at different seasons, in order to come to a right conclusion.

The two larger specimens on plates 32 and 35 have their pulp like that of a lemon, or rather paler, with only a *slight* tinge of orange. These large specimens require to be studied further on the tree, in order to determine whether they really belong to the *khattà* group or not. That on pl. 35 was called *kathairee nimboo*, from *kathàr*, or *kathàl*, a jack fruit, as in size and shape it is not unlike one. It is also called *rus kanker.* Although *kunker* means the lime nodules of which roads are made, it also (pronounced differently) means a kind of melon, and I am told that *kunker*, *kanker*, or *kankree*, all mean *kakree*, a variety of melon, and *rus kanker* is probably meant to indicate a *juicy melon*, the size of many specimens approaching that of a good-sized melon.

The specimens mentioned in this chapter are shown on plates 19 to 39.

CHAPTER III.

THE MALTA OR PORTUGAL ORANGES.

It should be understood that I give the above names to this type of oranges, not because all those I have seen have been introduced from Malta or Portugal, but because these are simple names of this variety of orange. In India, moreover, there is no indigenous name for this type of orange, as there is for those of the *sùntara* type. This would point to the notion that oranges of the Malta or Portugal type in India are of foreign origin. Moreover, in the time of Risso the blood orange was known in Paris as the *Orange de Malte,* while the bloodless variety of the same type was known as the *Orange de Portugal.*

Tien's Manual of Colloquial Arabic for Orange gives *burduqán* or *berdqán,* which are evidently corruptions of *Portugál.*

The Latin name given to this type of orange by Gallesio is *Citrus aurantium sinense,* which would indicate that the notion then was that it originally came from China.

I am unable to identify any of the oranges mentioned in Baber's memoirs with this type of orange,* unless it be his *nâranj,* which he compares, as I said in another place, with the sweet oranges of Lẹmghanât,

* *Vide* Appendix, No. 1.

Bajour, and Sewâd (Swât ?), where, he says, it is both "plentiful and good." Therefore, I repeat, his *nâranj*, although supposed so by his translators, could not have been the *nârandj* of the Arabs (the Séville orange).

A. de Candolle, in his "Origin of Cultivated Plants," under the heading of *orange* (Citrus aurantium of Linnæus) gives the following, which is hardly applicable to the oranges I know. "Oranges are distinguished from Shaddocks by the complete absence of down on the young shoots and leaves; by their smaller fruit, always spherical, and by a thinner rind. They differ from lemons and citrons in their pure white flowers; in the fruit, which is never elongated, and without a nipple on the summit; in the rind being smooth, or nearly so, and adhering but lightly to the pulp."

I shall take these characters seriatim, and show that in my opinion they do not at all fit in with the reality.

(*a.*)—Not only are the young unexpanded shoots of almost *all* orange trees hairy, but the young leaves and shoots of the large *ât anní* orange are as downy as those of most Pummelos or Shaddocks. Moreover there are undoubted varieties of Pummelos, as I shall show further on, which are *glabrous* (without down).

(*b.*)—As to size, the *bandir* orange of Tanjore, pl. 43, and the *punchí jambôle* of Kandy, pl. 56, are as large as the Pondicherry Pummelo, and the Shaddock of the English market, pl. 92, fig. *b.* The *Ât Anní* orange, pl. 112, is much larger than many Pummelos.

(*c.*)—As to oranges being always spherical, the plates will speak for themselves. Many are egg-shaped, pyriform, and also flattened.

(*d.*)—As to their differing from lemons and citrons in having white flowers, no nipple, smooth skin,

adhering but lightly to the pulp, I have seen what I considered an undoubted citron tree, with white flowers ; the sweet lemon I have never seen but with *white* flowers ; the *khattà*, which has most characters of an orange, is usually with a pronounced nipple ; almost all the *keonla* oranges have a flat nipple ; the *keonla* of Aurungabad, pl. 125, fig. *a*, the *mussèmbi* of Poona, pl. 44, fig. *f*, and many specimens of the Séville orange, are decidedly warty ; and many varieties of the Malta orange in the English market have their skin so adherent to the pulp that it is next to impossible to remove it without *cutting* it with a knife.

The fact is, it is rather puzzling sometimes to have to decide which is an orange, which a pummelo, and which a lemon, or citron. I am afraid it has been taken too much for granted that the lemon must be yellow, elongated, and with a mammilla and red flowers, and that the orange must be red, spherical, without a mammilla, and with white flowers. There is no good *natural* reason for this. It would appear much like Linnæus's classification of plants by the *number* of stamens.

The question whether the bitter and the sweet orange are merely varieties, one of the other, or distinct species, has not been satisfactorily answered. I would here ask *which* sweet orange is meant ? The Malta or Portugal, and its varieties ; or the *sùntara* or *kàmala* and their varieties ? I have elsewhere shown that there are two distinct types of *sweet* oranges, which may owe their parentage possibly to distinct wild kinds. The attempted replies, however, to De Candolle's question are very unsatisfactory, and he considered them contradictory. He quoted from Gallesio's " Traité du Citrus " :—" I have during a

long series of years sown pips of sweet oranges,* taken sometimes from the natural tree (seedlings), and some times from oranges grafted on bitter orange and lemon trees. The result has always been trees bearing sweet fruit, and the same has been observed for more than sixty years by all the gardeners of Finale. There is no instance of a bitter orange tree from the seed of sweet oranges, nor of a sweet orange tree from the seed of bitter oranges. In 1709 the orange trees of Finale having been killed by frost the practice of raising sweet orange trees from seed was introduced, and every one of these plants produced the sweet-juiced fruit."

The foregoing is either true or not true. If true, it is, I think, good evidence in favour of the two kinds having a distinct parentage, and that not improbably they are distinct species ; considering the opportunities both must have had of intercrossing, the latter surmise becomes stronger.

Curiously enough, however, De Candolle goes on to record that Macfadyen, in his "Flora of Jamaica," says "It is a well established fact, familiar to every one who has been any length of time in this island, that the seed of the sweet orange very frequently grows up into a tree bearing the bitter fruit, well attested instances of which have come to my own knowledge. I am not aware, however, that the seeds of the bitter orange have ever grown up into the sweet fruited variety. We may therefore conclude that the bitter orange was the original stock." Macfadyen asserts that in calcareous soil the sweet orange may be raised from seed, but that in other soils it produces fruits more or less sour or bitter. Duchassaing says that in Guadaloupe, the seeds of sweet

* Presumably of the Portugal type, as the *sùntara* type of orange appears to have been then unknown in Europe.

oranges often yield bitter fruit, while according to Dr. Ernst, at Caracas they sometimes yield sour, but not bitter fruit. The foregoing is all taken from De Candolle's recent book on the origin of cultivated plants.*

In my opinion the value of the three latter statements depends a great deal on two circumstances, viz.: (*a*) whether in Jamaica, Guadaloupe and Caracas, they had besides *sweet* orange trees also *bitter* ones; (*b*) whether the sowings were made by professional European gardeners or light-hearted negroes. If in all the places the two varieties existed and the seeds were interfered with by negroes, then the chances are that the latter, like the natives of India, never cared whether they were doing things *accurately* or *almost* so. The Indian has a saying: *Unnis, bis,*—that is, 19 or 20, *it's all the same!* This is the maximum of accuracy he ever attempts. Not impossibly, therefore, the "familiar and well-attested facts" may after all only be "popular errors." Let any one ask any Indian *mali* of the plains, "What comes of sowing the seeds of a *sweet* orange?" he will reply, "Without doubt a *sour* orange tree." The fact is he knows nothing at all about it, as in the Khasia hills all the *sweet Sùntaræ* oranges supplied to the Calcutta market come from trees raised from *seed,* and *in no other way!*

Gallesio, on the contrary, appears to record the sowings of professional European gardeners, and he speaks with no uncertain words.

When all is said, the fact remains that the Malta or Portugal orange, in its unripe state, is *sour,* and that, therefore, it probably originated from some *sour* wild

* It should be however noted that the writers describe only the *flavour of the fruit* and give no other characters of the tree, and the *flavour* may alter very much.

parent; but for reasons stated in the chapter on "Séville Oranges," I doubt whether the bitter or Séville orange could have been the parent of this "C. aurantium sinense" of Gallesio. Probably also the Séville and the Portugal oranges are more closely allied to each other than both are to the *sùntara* type of Indian oranges.*

I know that recently the Malta or Portugal type of orange has been on various occasions introduced into India. In Gujranwàla, Colonel Clarke introduced the Malta blood orange between 1852-56. I introduced the same, with other varieties of the Malta oranges, in Lucknow in 1863. Mr. Nickels introduced the blood orange from England, and the Portugal orange by seed from Suez in 1872. In Colonel Yule's "Glossary," it is stated in a note to page 490 that one of the writers sent from Palermo a large collection of all sorts of orange trees to Lahore in 1873. Then in Poona they have a variety of this type called *mussèmbi*, which evidently means Mozambique, and may have originally come from that coast of Africa. Over the south of India, the Malta varieties bear the name of *aranj*. In Tanjore, a yellowish variety is called by Europeans the Spanish orange. In Ceylon, this type of orange goes by the name of *pêni-dòdan*, which simply means, I am told, *sweet* round orange. Curiously enough all over the N.-W. Provinces, natives call the Portugal orange *Sylhet*. How this name came to be adopted I don't know, the Sylhet orange being a *sùntara*, and of a totally different type. It is only in Tanjore that I found a variety of the Portugal orange called by a native name, *bàndir*. What this may mean I do not know.

* Possibly the seed of the Portugal orange may have produced *a* sour and bitter orange, but not *the* bitter or Séville orange.

Therefore, taking the want of an indigenous name in India for this type of orange and its varieties, it would appear that when the Arabs carried the Séville from Western India further west, and finally into Spain, this sweet variety had not yet reached Western India, or at all events those parts of India then known to the Arabs.

A. de Candolle, quoting from Gallesio, gives some interesting historical data regarding this orange. He first proves that the orange trees brought from India by the Arabs into Palestine, Egypt, the south of Europe, and the coast of Africa, were not the sweet-fruited ones. Up to the fifteenth century Arab books and chronicles only mention bitter or sour oranges. However, when the Portuguese arrived in the islands of Southern Asia, they found the sweet orange, and apparently it had not previously been unknown to them. The Florentine who accompanied Vasco de Gama, and who published an account of the voyage, says: "there are plenty of oranges, but all sweet." Neither this writer nor subsequent travellers expressed surprise at the pleasant taste of the fruit. Hence Gallesio infers that the Portuguese were not the first to bring the sweet orange from India, which they reached in 1498, nor from China, which they reached in 1518. Besides, a number of writers in the beginning of the sixteenth century speak of the sweet orange as a fruit already cultivated in Spain and Italy. There are several testimonies for the years 1523 and 1525. Gallesio goes no further than the idea that the sweet orange was introduced into Europe towards the beginning of the fifteenth century, but Targioni quotes from Valeriani a statute of Fermo, of the fourteenth century, referring to citrons, sweet oranges, &c., and the information recently collected from early authors by Goeze, about its introduction

into Spain and Portugal, agrees with this date. "It therefore, appears to me probable," says De Candolle, "that the oranges imported later from China by the Portuguese were only of better quality than those already known in Europe, and that the common expressions, Portugal and Lisbon oranges, are due to this circumstance."

De Candolle adds that "in the Malay archipelago the sweet orange was believed to come from China. It was but little diffused in the Pacific Isles at the time of Cook's voyages." And he concludes by saying, "We come back thus by all sorts of ways to the idea that the sweet variety of the orange came from China and Cochin China and that it spread into India perhaps towards the beginning of the Christian era."

All these researches would have been far more interesting, if one could feel sure *which* sweet orange was meant. There is, however, not much doubt that the Portugal sweet variety is meant.

Gallesio's "Traité du Citrus" was published in 1811, and Risso and Poiteau's "Histoire Naturelle des Orangers" was published in 1818. The latter gives only two plates of oranges which come anything near those of the *sùntara* type, viz.: the "Bigaradier Chinois" and the "Bigaradier à feuilles de myrte." And he adds these were then rare in Europe. So that the sweet oranges which De Candolle refers to in the fourteenth, fifteenth, and sixteenth centuries can hardly mean any other race than those of the Portugal type, of which Risso gives a large number of plates, and describes many others, all then known in Europe. All these European varieties very probably originated from seed, as in 1709 the gardeners of Finale introduced the practice of raising orange trees largely from seed. It would appear, therefore, that up to the time

of Risso, in 1818, or at all events Gallesio's in 1811, in Europe, the *sweet* orange meant was that of the Portugal type, the round, *close-skinned*, subacid and sweet orange (when ripe)—the *Citrus aurantium sinense* of Gallesio.

At the beginning of the sixteenth century (A.D. 1519) the Emperor Baber, in his memoirs, besides the oranges of Lemghanât, Bajour, and Sewâd, mentions those of Khorassàn, and that there was a trade in oranges between Asterabad and Samarkand. For oranges to be so plentiful there as to be carried to distant places (about 1100 miles), it would presuppose that this sweet orange had been introduced into Central Asia at least one, or perhaps two centuries before. But whether it found its way there from Western India and the Persian Gulf, or from the Mediterranean, by way of Syria, I have no means of ascertaining.

In the "Flora of British India," under the species Citrus aurantium of Linnæus, var. 1, *aurantium proper*—little is given beyond what I have already extracted under the heading of "Séville Oranges." The author adds for this variety "petiole naked or winged, pulp sweet, yellow, rarely red."

In order to distinguish the two types of sweet oranges, I shall give a more detailed description of this Portugal orange type. Tree, *not* slender; leaves, typically large, with a *faint* and indistinct scent; petiole, oftener only *margined* than winged; spines, usually mere points; flowers, large white; fruit, with a *closely-fitting skin*, never baggy; when cut open, a distinctive odour is emitted, which I found common to all varieties of this type, and which cannot be described in words; pulp, not of a bright orange, often only yellow orange; centre, small, and mostly *not* hollow; seeds, white when cut. In some varieties, the pulp is streaked with blood

or claret red; in others, the whole pulp is of this colour. The latter varieties have usually a redder exterior than the bloodless ones. Mr. A. Y. Gubboy, who was in Canton, informed me that they have there a *sour* blood orange which never sweetens.

In Kandy I found a curious and interesting variety of this type, shown in pl. 56. Some said it was nothing but a small pummelo; others called it a sour orange (*amool dòdan*). Studying it more closely, it appeared to me an overgrown, thick-skinned and *yellow* orange of the Portugal type (C. aurantium sinense Gall.). It is not impossible that this Kandy yellow orange may be an intermediate form between the Portugal type of orange and the Pummelos proper, the latter being still more elephantine in the growth of all their parts, including the enormous wings of their petioles.

Nota bene.—I believe the Aurantium verrucosum of Rumphius, shown on the Atlas plate 59, figs. *d* and *e*, is of the *Portugal orange type* (vide Appendix, 41 (*m*)), although Miquel in his "Flor. Ind. Batav." calls it C decumana, var. verrucosa. Pls. 40 to 58 show oranges of the Portugal or Malta type.

CHAPTER IV.

THE "AMILBÊDS" AND THE PUMMELOS.

REGARDING the *amilbêd,* all that the Emperor Baber said about it in his memoirs is this: "I have seen it first during this present year (I suppose he refers to the year in which he was writing his memoirs). They say that if a needle be thrust into the heart of it, the needle melts away. Perhaps this may proceed from its extreme acidity, or from some other of its properties. Its acidity may be about equal to that of the orange and lime."

It should here be observed that the words "orange and lime" are the translator's words, and as these have been often abused, and given to totally different varieties, it is not easy to tell what they may mean. Anyhow, we have in Baber's time, an extremely acid citrus called *amilbêd.** It appears to have been then far from common, that is about 300 years ago, otherwise he would have hardly troubled himself to write, "I have seen it first during the present year."

With regard to the pummelo, Baber's memoirs make no mention whatever of this citrus. Had it been known in Hindostan in his time, it is not likely that so large and striking a citrus would not have been presented to him. It is therefore reasonable to infer that in Baber's time, or about 300 years ago, the

* *Vide* Appendix, No. 1 (*j*).

pummelo proper, as we see it to-day, was not known in India. Moreover, Roxburgh says that the pummelo was brought to Calcutta from Java.

In support of Roxburgh's statement, there are other circumstances. The Bengalis, even at the present day, call the pummelo *batàbi lemboo* (Batavian citrus). They have no *v* in their language, and therefore *batàvi*, would naturally be transformed into *batàbi*. Then, as this citrus was propagated, and crept up country from Calcutta, still under the name of *batàbi lemboo*, its name underwent another transformation. Natives of India have often a curious way of assimilating a foreign name, by calling it by some Indian familiar name, which sounds like it, irrespective of spelling. For instance, the proper English name *Newberry*, is at once turned by them into *lomree*, the native name for a fox; and the English name of *Buller* is turned by them into *gooler*, the name of one of their numerous fig-trees (*Ficus glomerata ?*). So that it is not improbable that they soon turned the foreign name *batàbi* into *mahtàbi*, like a moon, *mahtàb* being the Persian name of that satellite. Curiously enough, the large oblate pummelo is not, in size, very unlike the apparent size of the moon. Another native name for the pummelo is *chakòtra*. This also is good evidence of this fruit being of foreign origin, the old name of Batavia having been *Jacàtra*. In the same way that learned natives have derived the name of *mahtàbi* from *mahtàb*, the moon, so did Pundits endeavour to give a Sanskrit origin to the word *chakòtra*, as will be seen in the chapter on the derivations of citrus names. Further, all the south Indian names of this fruit, though strangely transformed, bear the stamp of a foreign derivation. There remains little doubt then that the pummelo proper in India, came from Java, and probably after

Baber's time; now, however there are many varieties, and natives in Upper India call one variety *mahtàbi*, and another *chakòtra*.

I do not think there would be much advantage in separating the *amilbêds* from the pummelos. They may no doubt have had a different origin, but at present the difference in the fruit is slight. The *amilbêds* are sour, and some have a pulp of an orange tinge, while the pummelos are sour-sweet, with a dash of bitter, and some have a pink or red tinge. The leaves do not differ much, the wings of the petioles of the latter being larger than those of the former. At the most, they might be considered as varieties of some older parent. Anyhow, the *amilbêds* appear to have been overlooked by botanists, as, not even has their name been mentioned. It is impossible to say whether they came into existence in India, or are of foreign origin.

With regard to the pummelo, Alph. de Candolle, in his "Origin of Plants," says: "Rumphius believed it to be a native of Southern China, neither he nor modern botanists saw it wild in the Malay archipelago . . . . according to Loureiro, the tree is common in China, and Cochin China, but this does not imply that it is wild. It is in the islands to the east of the Malay archipelago, that the clearest indications of a wild existence are found. Forster formerly said of this species, 'very common in the Friendly Isles.' Seeman is yet more positive about the Fiji Isles. 'Extremely common,' he says, 'and covering the banks of the river.' It would be strange if a tree, so much cultivated in the south of Asia, should have become naturalized to such a degree in certain islands of the Pacific, while it has scarcely been seen elsewhere. It is probably indigenous in them, and may perhaps

yet be discovered wild in some islands nearer to Java."

De Candolle, from the foregoing, evidently thinks that the pummelo is a *distinct species*, and that its wild progenitor, yet undiscovered, will, by further search, turn up somewhere. This may or may not happen; but what I should like to ask is this: Is the cultivated C. decumana so different from others that it is imperative it should owe its existence to a *distinct* wild species?

Alph. de Candolle says: "I take this species first, because its botanical character is more marked than that of the others. It is a larger tree, and this species alone has down on the young shoots and the under sides of the leaves. The fruit is spherical, or nearly spherical, larger than an orange, sometimes even as large as a man's head. The juice is slightly acid, the rind remarkably thick."

Sir J. D. Hooker, in his "Flora of British India," under the heading of *Citrus decumana, Linn.* (Shaddock, Pummelo, Pompelmoes), says: "Young shoots pubescent, petiole broadly winged, flowers large white. stamens 16 to 24, fruit large pale, globose or pyriform, rind thick, pulp pale, sweet or acrid. Commonly cultivated in India. A native of the Malayan and Polynesian islands. A tree 30 to 40 feet, leaflets 6 to 9 inches. Fruit often very large, pulp yellow, pink, or crimson, sweet or acrid, vesicles distinct."

I made special observations on the Citrus in various parts of India and Ceylon, with the view of ascertaining how far the supposed *distinctive* character of *pubescence* on the young shoots and leaves of the pummelo is based on fact. The result of my researches I am afraid is that this pubescence, or minute hairs, on the young shoots and leaves of the pummelo, as a

distinctive specific character, will have to be abandoned. I found that the young unexpanded leaves of almost *all* the Citrus—orange, lemon, citron, lime—are covered with hairs. They can be easily made out by means of a good magnifying glass, on the edges of the leaves and underside of the mid-rib and petiole. I had young seedlings of the *amilbêd* and of the *ât'anni kalan* (a pummelo); both of them had pubescence on the young leaves and the young stems. The only difference that I could find was that the pummelo seedlings had a *little more* of it. The *Lahore gulgul*, pl. 32, has the young leaves and stem, and old leaves also, as tomentose as most pummelos; and the *kathairee nimboo* of Bulrampore, pl. 35, is similarly furnished, and has tomentum also on the *calyces of the flowers*, which are purple. This belongs to a totally different race of Citrus from the pummelo proper. The fact, however, which removes all doubt about this point is this. In the Etawah Public Garden there is a row of ten pummelo trees, three of which are of the permanently pubescent kind, and one of these is less pubescent than the other two, while the remaining seven trees are entirely *glabrous* from the commencement, that is, as glabrous as the orange, the lemon, the citron, and the lime trees. Moreover, Loureiro, at p. 467, under the head of "Citrus decumana," describes it as "spinous and *glabrous*," and Rumphius, in describing the 4th sp. of pummelo, says: "The leaves beneath are *not downy*, as in the common kind. Its fruit is the largest of all." See Appendix 41 (*a*).

No one would think that all these ten trees in Etawah are not pummelos. Three of them—the tomentose—are of the rather pyriform variety, there called *mahtàbi*; and seven of the glabrous variety. The latter have oblate fruit, and are called there

chakôtra, and one of them bore the enormous gourd-like pummelo outlined on pl. 80.

So that all the pummelo trees I have examined can be divided into three sub-varieties, as far as pubescence is concerned, viz. :—

(*a.*) Pubescence, as in other Citrus, on the young *unexpanded leaf buds only.*

(*b.*) Pubescence to a greater degree than (*a*) on the young leaves and stems. This pubescence, however, is afterwards shed, and neither the leaves nor the green stem show any trace of it. Perhaps a magnifying glass might detect a few remaining hairs on the *edges* of leaves and on the under part of the midrib.

(*c.*) Pubescence to a greater degree than (*b*), with the additional variation that it is *permanent.* The old green stems have it, and the oldest leaves retain it on their edges and undersides of the midrib and petiole; also on the edges of the petiole wings. The more pubescent kinds may have some slight difference in the shape of the leaflet, as shown in pl. 82, fig. *c.* It is generally more rounded and oftener emarginate, while the glabrous varieties have their leaflets longer and more lanceolate, as in fig. *a*, pl. 82; and sometimes they appear to be entire, though the oil cells of the edges of the leaves are rarely extinct. There is no other difference that I can make out. With regard to the size of the pummelo tree, I have only seen one which could bear being styled a large tree, and that was in the Padshabagh, in Lucknow; all others have been more or less bushy. I fancy the size depends a good deal on the training, and whether they are grown from seed or bud. In India they are usually budded low down on the stock, and are not trained on one stem, so that they branch out, and instead of developing in height they develop in breadth.

With regard to thickness of skin, in the Bombay market I found a large globose, red variety, which, with a diameter of seven inches, had a skin varying from $\frac{1}{2}$ to $\frac{1}{4}$ inch in thickness. This is the thinnest skinned pummelo I have seen, and a very fine variety it is. When cut open, its redness compares strongly with that of raw beef. But when the vesicles are removed and put on a plate they are of a rosy crimson. Other varieties have a pulp as pale as that of a lemon, such as the Ceylon pummelo, and some varieties of the Calcutta pummelos. The shape of the fruit varies from oblate at both ends, to globose, slightly pyriform, and distinctly pyriform ; the size, from that of a big Malta orange, to the "decumana" proper of pls. 80 and 81. The colour of the exterior is lemon yellow, but both in the Central Provinces and in Rampur some had a distinct *red blush* over a large portion of their surface.

Now that I have touched on the subject of pubescence, I will add that at the Horticultural Garden of Pondicherry they showed me what they called a wild Citrus (oranger sauvage). The tree had an emarginate leaf which was like a small lemon leaf. It had a *great deal* of pubescence on the stem and underside of the midribs and petioles. It had spines like those of the lemon, and its petioles had neither wings nor ridges. They had, however, an indication of a joint between the leaflet and the petiole. The leaves had slight crenations. The oil cells and venations of the leaves were those of a Citrus. The leaves when crushed gave a faint and pleasant odor of sweet briar. As I did not see either the flower or the fruit of this "oranger sauvage," I cannot say what it exactly was. The tree in question was on the left hand side of the entrance as one goes in, and formed part of a hedge which had been clipped.

Further, in an allied genus, the Œgle Marmelos (Bœl), the minute leaves are covered on both sides and edges with a short brownish down. It is shed as the leaves grow, first off the upper surface, and lastly off the edges and nerves of the lower side, so that pubescence, more or less extensive, and more or less permanent, is a character, I believe, not only of the whole genus Citrus, but also of allied genera, and therefore it cannot, in my opinion, be considered as a *specific* character of the supposed species *Citrus decumana*—the Pummelo proper. It would appear a question only of *degree* of pubescence and not of a *distinctive specific character.*

Then, if the Pummelo proper (the Citrus decumana of Willdenow) is *not* a distinct species, what is it? Perhaps it would be better to put a more extended question, viz., "What are all the 'decumana' (large) Citrus *in general?*" The origin of the elephant I consider is an over-fed animal, largely surrounded by tropical forest, where he required little exertion to fully feed himself and grow generation after generation to his present full size. What the elephant and similar large animals are to the other Mammalia, so I surmise, the Pummelos and other huge Citrus were originally to the smaller varieties of Citrus. They probably originated under circumstances of tropical or subtropical luxuriance, with their roots branching among ingredients which tended rather to a sort of elephantiasis of the fruit than to its sweetness and juiciness. Once this habit of growth became fixed, it is easy to imagine that it could be still further increased under more suitable conditions for this particular development. The largest pummelos I have seen came from the district of Etawah—a rather dry district. It gets regular rain usually from

July to September, but its soil is noted for the amount of " kunkur " (lime nodules) it contains. Lime being a large ingredient of the ashes of the Citrus wood, it is not improbable that this element, with tropical and sub-tropical conditions of luxuriance, may have had a good deal to do with the origin of the Citrus *decumana.*

Mr. Ridley, of Lucknow, made an interesting experiment with lime-soil for the Citrus. He planted several kinds on nothing but *demolition mortar* and only watered them. They grew luxuriantly and bore good fruit.—(*Vide* chap. on " Citrus cultivation.")

Taking everything into consideration, not impossibly the pummelo may have branched off into its present form and characters from no other source than the Citrus aurantium sinense of Gallesio, *the Malta or Portugal orange,* or both may have sprung from a common ancestor. At all events the former appears to have had its cradle in Southern China and Cochin China.

Leaving pubescence out of consideration now that we know it does not count, we have a closely fitting skin like that of the Malta orange. The emarginations at the base of the pulp carpels, as shown in section, appear to be a repetition of similar ones often met in that orange, such as those of pl. 82, *c, c.* They are commonest in the pummelo and Portugal orange. Then the pummelo proper and the Malta orange are the only Citruses I have seen which present varieties with red or blood colour in their pulp, while the *amilbêds* have often an orange tinge in their pulp.

The lemon coloured exterior of the pummelo might perhaps seem a difficulty, the Malta type of Citrus being orange. Besides different shades of orange in different varieties, I have shown that in Kandy they

have an orange of the Malta type, with a purely citron-yellow exterior like that of pummelos. Moreover, I have seen true pummelos with *red cheeks.—Vide* Appendix, No. 26.

Risso, p. 132, says of the pummelos—" en effet, les pompelmouses ont de l'affinité avec les oranges douces, et avec les lumies, qui sont deux groupes très eloignés l'un de l'autre." While Gallesio groups the " Pomo d'Adamo " of Palestine (a shaddock) with the Séville orange and says it is intensely bitter.*

Further, the *Jhambiri* presents two varieties, one yellow-skinned, the other orange-skinned. Otherwise they appear indistinguishable. The yellow skin of the pummelo would naturally carry with it a pale pulp, which afterwards may by reversion, have acquired some blood colour, increased later on by selection. So that we have now white, pink, or beef-coloured pummelos; others with mixed colours and entirely yellow, and also red-checked pummelos. As to the tomentum of some varieties, it may have originally been a part of the general elephantisation of the whole tree; that is a luxuriant growth of the natural tomentum found on the young unexpanded leaf buds of *most* Citrus. In the pummelo proper we also find typically huge leaves of a leathery consistence, and enormous petiole wings which are also indicative of luxuriance. This increased tomentum in some varieties may have been subsequently lost by reversion to its original scantiness.

If the foregoing arguments are well founded, we ought to find " elephant " varieties in other types of Citrus; and so we do, in abundance. The *kathairee nimboo*—curiously enough, a very *tomentose* variety—

* The modern Adam's apple of the English shops, said to come from Palestine, I found was only sour without bitterness.

appears to be an elephant form of the warty *khattà* orange group, pls. 32 and 35. . . . The *ât Anni*, also *tomentose*, appears to be the "elephant" variety of the *sùntara* group, pl. 112. The Kumaon lemon, or *gulgul*, may be taken as the "elephant" variety of the lemon group, pls. 187 and 188, and the *mawling* of Mangalore, and the *madhkakree* of Almora, pls. 148 and 171, would, perhaps, be the "elephant" representatives of the Citron group. For all I know, there may be others, which I may not have come across. It would, therefore, appear that each type or race of Citrus has, or may have, its variety *decumana*. If so, it is no wonder that the *wild original* of the pummelo has never yet been discovered. It probably only required the evolution of a yellow orange, like that of Kandy, for this "decumana" citrus to have come into being, first as a product of luxuriant growth, and afterwards as the result of selection. The only parts of this Citrus which have not been elephantised are the spines. These, however, are usually well developed under conditions just the *opposite* of luxuriance, some of the branch buds, instead of developing normally, remaining dwarfed as spines. If grown from seed, however, the spines of the pummelo might also be large, like that of most other seedlings.

Alphonse de Candolle, in searching for the cradle of the pummelo, seems to lay great stress on the observations of Sleeman, that in the Fiji Isles, it is extremely common, and covering the banks of rivers. De Candolle appears to infer from this that, being so common, there must be in that vicinity some centre containing the wild parent of this supposed distinct species, the *Citrus decumana*.

From experiments I have made, I found that most of the citrus fruit will float in water ; so will that of the

Œgle Marmelos, and of the Feronia elephantum. But the *best floaters of all are the large pummelos.* They float so well, that half of the fruit remains out of the water. Moreover, Rumphius says (and this is well known), that the pummelo lasts a long time without spoiling, and is taken on long voyages on account of its keeping quality. Now if only one pummelo seed had found its way on high ground and got naturalised there through the agency of birds or other animals, the fruit of its tree, when ripe, would fall and roll into some water channel, whence it might be easily carried by floods into rivers. If the fruit stranded on any bank, it would eventually rot there, and its seeds would easily germinate, or they might be further disseminated by birds and other animals along the bank. Finally the whole river banks might in the same way become inseminated with pummelo trees. Moreover, this fruit floats probably as well as the cocoa-nut, and although it might not stand immersion so long as that nut,* it is not at all improbable that when once the pummelo tree had found its way to river banks, and its fruit dropping into the water, its dissemination to other islands in the vicinity may have been easily effected by ocean currents, tide and wind. If it floats so well in fresh water, it will float much better in salt water. This is supposing that birds and other animals had nothing to do with its dissemination, and that the savages of those islands, who continually paddled from one island to the other, carrying with them seeds of every fruit they found fit for food, had no hand in covering the banks of the Fiji Islands with pummelo trees. Putting aside, however, the fact that this tree is one of the hardiest of the Citrus genus, it is asserted

* For all I know, however, the oily surface might keep off the close contact of the water, and preserve it for a long time.

that in South America whole forests of orange trees have been created through the *sole* agency of *parrots.*

Considering the numerous varieties of pummelo there are in India at the present day—the white, the pink, the red pulped; the oblate, the globose, the ovoid, the pyriform ; the very large, the middling, aud the small; the sweet, the sour, and the acrid ; the thick-skinned and the thin-skinned ; those with rounded, emarginate leaves, and those with long lanceolate leaves ; those with lemon-coloured fruit, and those with a blush of red ; finally, the tomentose, the semi-tomentose, and the glabrous varieties—one might, perhaps, infer from this richness of varieties that there must be in India some centre of wild pummelo, from which all these have originated. Yet nothing appears clearer than that the pummelo proper is of recent introduction in India, by way of Batavia and Calcutta, and perhaps also southern India.

From all that can be gathered, it appears likely that the pummelo was evolved, or at all events got its modern characters fixed, in the Malayan archipelago. It should not, however, be supposed that India was incapable of evolving a pummelo of its own. Three hundred years ago, the Emperor Baber attempted to describe the *amilbêd.* This appears to have originated in a yellow-skinned variety of some sour orange, not improbably a close ally of the *C. aurantium sinense,* Gall. It has a closely fitting skin, an orange or white pulp, and a leaf with the characters of the Malta orange leaf. Three hundred years ago, it appears to have been uncommon in India, and even now it is cultivated more as a curiosity than for commercial purposes. Being sour, and there being many other sour citrus of a more convenient size, it has never become widely disseminated. Nevertheless, pl. 67 shows an *amilbêd* which is larger than

the pummelo proper or shaddock of pl. 92, and in Pondicherry, I found a still smaller pummelo, with a girth of only twelve inches, that is, half an inch more than the yellow orange of Kandy. Had there been evolved a sweet and sub-acid *amilbêd*, the further elephantisation of this citrus in India would have become easy. Of the *amilbêds* figured, one had eight pulp carpels, and nine others from eleven to sixteen carpels, while of the pummelos proper, one had thirteen carpels, and six others from fourteen to twenty-one, so that the hugeness of the *amilbêds* and pummelos may be due, not only to excessive growth of all parts, but also to a sort of doubling, or proliferation of the carpels. In that case, the outer skin would have either to burst, and so lose one of its great factors in the struggle for existence, as I have attempted to show in the chapter on Morphology, or it had to expand and make room for its multiplied contents. The normal number of carpels—five—I have only found in the diminutive *qumquat;* in all other citrus there has been a multiplication of pulp carpels, until we reach the largest number in the pummelos.

In accounting for the size of certain citrus, we should not lose sight of the possibility of their hugeness having been originated by a *fusion of two ovaries* In pls. 223 and 224 are figures of double lemons, which I got from the Etawah jail garden, and from the English shops; one had no seeds; but in the English shops I came across two others, both of which had seeds. It is therefore not unlikely that by sowing seeds of double citrus, and by selection, eventually a large and perfectly round fruit may be obtained, which may have ceased to show any trace of fusion of the two ovaries, except in the increased number of carpels, and size of the fruit. Pls. 72 and

83 show pummelos with a suspiciously *elongated* centre, which probably tells a tale of its birth, although its *exterior* may have lost all trace of its origin.

Finally Dr. John Shortt, writing from Yercaud, in the Shevaray hills, says "We have the pummelo, which fruits largely, some weighing four or five lbs., but worthless, as the pulp is acrid, bitter and sour. The pummelo is a most delicious fruit, about the coasts of South India, both the white and the pink varieties; but plants or seeds, introduced up here, from excellent fruit-bearing trees on the plains, become worthless here. It is apparently the fault of the soil and climate. Our pummelos are not wild kinds, but of the best cultivated varieties. When brought up here, they go like that." This shows how cautious one should be in declaring a citrus wild simply because it happens to be acrid and uneatable; all fruit trees are liable to variation by change of climate and soil, but there is none perhaps which is more sensitive of change of soil and climate, than the sweet kinds of citrus in cultivation.

Pls. 59 to 92 give figures of *amilbêds* and pummelos.

CHAPTER V.

THE "SÙNTARA" ORANGES.

IN Baber's memoirs the following occurs, which is stated to have been said by Humayoon: "In Bengal there are fruits which have an acid flavour, though they are not of equal excellence with the *amratphàl* (sweet lemon). The one is *kàmilah*, the other is the *sàmtereh*, and are larger than the orange, but are not sour. The latter is found in Bengal at one village, called Senargam, and even in Senargam it is found in the greatest perfection only in one place. There is no pleasanter fruit than the *sàmtereh*."

There is hardly any reason to doubt that the *sàmtereh* and *kàmilah* of Humayoon are the *sùntara* and *keonla* of modern Indians. The Bengalis still call the *sùntara* of Sylhet and the Khasia hills, by the name of *kàmlah lemboo*. *Lemboo* is a sort of generic name, which Bengalis use for *all* kinds of citrus. It is a corruption of *limo*, and in the chapter of derivations I have endeavoured to trace the origin of the latter designation.

About 300 years ago the *sùntara* orange appears to have been rare in India. Then it appeared to have found its way only to Bengal, and even there to have been limited to one particular locality, Senargam. At the present day it is to be found almost all over India. In the Khasia hills, and further north and to the west, in Bhotan, Nepal, and Kumaon, it grows

in a semi-wild state. In the chapter on the cultivation of the citrus, I have described the mode of raising it in the Khasia hills. *Primâ facie*, judging from its numerous varieties that now exist all over India, and from its semi-wild state all along the north-eastern frontier, it might appear an indigenous type of orange. It is not improbable, however, that it only became naturalized there at a very remote period,

In Lahore it is now called *kàrna* or *sùngtara*. In Delhi it is grown extensively under the name of *sintra* or *rungtra*. In Bengal under the name of *kàmlah*. In the Central Provinces it is largely grown as the *sùntara* orange. In South India, under various other names, and in Ceylon, under the name of *jàwa nàrun*, and also *kònda nàrun*.* All these are varieties of one and the same orange, most commonly known by the name of *sùntara*, a pleasant mixture of sub-acid and sweet pulp, enveloped by a *very loose* and aromatic skin. It varies from the very sweet, such as the *sántola* of Butwal in Nepal, to a sour-sweet orange. The *surkh nimboo*, the *hazàra*, and the *kumquat*, I consider as varieties much allied to the *sùntara* orange, all three are quite sour, and never sweeten.

Although in many parts of India it is grown side by side with the Portugal type of oranges, the *sùntara* is a totally different kind of orange, and has scarcely anything in common with them, more than the characters of the genus.

We are now beginning to see through the tangle of *sweet* oranges, and are able to separate them into two distinct types—the Portugal or Malta orange type

* Both these Ceylon varieties are pictured in Miss North's Gallery, No. 226, Royal Gardens, Kew. The *kònda nàrun*, is the *green* orange. The other is the *jàwa nàrun*.

(C. aurantium sinense, Gallesio), and the Sùntara type (C. aurantium sinense of Rumphius).*

If this type of orange were obtainable on the Western coast of India, at the same time that the Arabs took from there the Séville orange further West, they would have probably also taken it, although the Séville orange is, perhaps, one of the hardiest known varieties.

If it were easily obtainable in China or elsewhere, at the time the Portuguese introduced the C. aurantium sinense into Portugal, they probably would have introduced this also.

There is evidence, however, that the *sùntara* type of orange did not get to Europe till much later; as I said, Risso, in his monograph, gives only two plates of what I look upon as this type of orange.

(*a.*) *Bigaradier chinois* (pl. 94, fig. *j*).—Leaves small, oval-acute; fruit small, round, oblate at the base, slightly depressed at the summit, reddish yellow; skin thickish and spongy, lightly adherent to the pulp, which has large vesicles, divided into eight quarters; juice acid, and slightly bitter. In South Europe it resists the winters. In August the fruit is collected to candy it. In Paris it is very rare, as the demand for it is small.

The *Hazàra* orange of India (pl. 94, figs. *a* to *d*), a sour kind, would fit into Risso's description of the foregoing.

(*b.*) *Bigaradier à feuille de myrte* (pl. 117, fig. *j*).—Leaves very numerous, closely set, and almost imbricated on the branches, about the size of myrtle leaves; flowers small; fruit round, reddish yellow, shiny, chagrined by the oil cells; pulp in six or eight quarters, with a sweet juice, and only slight acidity.

* For aurantium sinense of Rumphius, see Appendix 41 (*l*).

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It resembles the B. chinois, and many consider it only a variety of the former. In Risso's time a variety of this, marked (*a*) in his work, was much multiplied in Paris on account of its smallness and beauty (often no larger than represented in the plate). A variety of it existed in Italy, but was still very rare. Risso having given only two plates of this type of orange has some significance. It was then only recently introduced, and there was little time yet for new varieties to have come into existence from seed.

The "B. à feuille de myrte" corresponds almost exactly with the *Mandarin* orange, which has an exterior so shiny that it looks as if it had been *varnished.* Risso and Poiteau published their monograph at the beginning of the present century.

Great confusion has arisen from travellers in the East mentioning only a *sweet* orange that they may have come across. In the "Penny Cyclopædia" the following occurs: "Captain Turner, in the account of his journey to Teshoo Loomboo, mentions the orange as delicious; and Mr. Saunders, who accompanied him, describes many orange and lime trees as found at the foot of the hills in approaching *Buxadwar.*' Alph. de Candolle, at p. 185 of his "Origin of Cultivated Plants," repeats this passage, quoting it from Royle's "Illustr. of the Himalayas."

There is little doubt in my mind that the sweet orange here mentioned by Captain Turner is that of the *sùntara* type, as even up to this day it is grown in those parts in a *semi-wild state.*

It would appear that botanists have either overlooked the fact that there existed *two types* of *sweet* orange, or may have thought the distinction *unimportant.* In truth, neither of them is quite sweet; but a mixture of more or less sweetness, with more

or less sub-acidity, according to the soil and climate and amount of cultivation they may be subjected to, and their degree of ripeness. Unripe, they are both acid, the acidity decreasing and changing into sugar as ripeness proceeds.

The sweetest orange of the *sùntara* type is that known as the *Butwal* orange. Natives also call it *sùntolah*, or *sùntowrea.* Butwal is the district on the borders of Nepal, where it grows semi-wild. The sourest varieties of this type are the acid *surkh nimboo* of the natives, and also the *hazàra*, or *qum-quat*, orange. As I said, these never sweeten.

Sir J. Hooker, under the heading of "Citrus aurantium," says it is found in the "Hot valleys along the foot of the Himalayas, from Garwhal eastwards to Sikkim, and in the Khasia mountains. A small, slender tree, flowering in the rains and fruiting after them, growing, where I found it, in the very bottom of valleys, and where it did not occur to me to doubt its being indigenous. The fruit was somewhat flattened, or nearly globose, about two inches diameter, high coloured, and uneatable, being (if I remember aright) mawkish and bitter."* His stating that it was "a small, slender tree" inclines me to think that he was describing a sour orange of the *sùntara* type, as all the varieties are slender trees, with small flowers. As to its flowering in the rains, *all* kinds flower more or less in the rains, but their principal season of flowering is spring.

I shall endeavour to give a detailed description of the *sùntara* type of orange tree. A small, slender tree, with slender lanceolate leaves, sometimes as small as those of the common *myrtle*, and with a very distinct, strong scent; flowers small, the main crop of

* I repeat this extract here for the sake of convenience.

which come out in February or March, and the after, or *Dumrêz*, crop in June or July, during the rains; fruit varies in shape, from the flat oblate-globose to the pyriform, sometimes quite smooth, at others sub-warty. The colour varies from orange-yellow to lobster-red, and sometimes in part to tomato-red; it is mostly baggy, with a loose skin, sometimes so loose that the pulp-ball *wabbles* inside it; the white pithy part between the rind and the pulp is frequently almost absent, and the large oil cells of the rind can be easily dissected into balloon-shaped vesicles; the colour of the pulp is often much deeper than that of the bloodless kinds of the Portugal type. The flavour varies from very sweet to a mixture of sweetness and sub-acidity (which most of them have), and to a pure acid. The centre of the pulp is mostly hollow, and the carpels loosely adherent. The seeds are green, when cut.

It is possible that this type of orange may be indigenous to the north-eastern border hills of India, but probably it was naturalized there at a very remote period; that it originally came from China, or Cochin China, either directly across the border or by way of the Malayan peninsula. The reasons for taking this view are given in the chapter on the Origin of the Citrus.

De Candolle, under the heading of "Sweet Orange," states: "Royle says that sweet oranges grow wild at Sylhet (meaning no doubt those of the *sùntara* type, now still semi-wild), and in the Nilgiri hills, but his assertion is not accompanied with sufficient detail to give it importance. . . . On the other hand, Brandis and Sir J. Hooker do not mention the sweet orange as wild in British India; they only give it as cultivated. Kurz does not mention it in his 'Forest

Flora of British Burmah.' Further East, in Cochin China, Loureiro describes a C. aurantium with sour-sweet pulp, which appears to be the sweet orange, and which is found both wild and cultivated in China and Cochin China. Chinese authors consider orange trees in general as natives of their country, but precise information about each species and variety is wanting on this head. From the collected facts, it seems that the sweet orange is a native of Southern China and Cochin China, with a doubtful and accidental extension of area by seed into India."

It would have been much more interesting if we knew, as I said, to what type of sweet orange De Candolle refers in the foregoing. With regard to the *sùntara* type of orange, his conclusion would appear as the probable one.

He goes on to say, "If the sweet orange had been cultivated in India, it would have had a special name in Sanskrit; the Greeks would have known it, after Alexander's expedition, and the Hebrews would have early received it through Mesopotamia. This fruit would certainly have been valued, cultivated, and propagated in the Roman empire, in preference to the lemon, citron, and bitter orange. Its existence in India must, therefore, be less ancient."

I would here mention that although India is a very small word, it means a *very big* thing. I believe that Alexander's expedition did not reach much beyond the Indus, and in those days of difficult communication, although the *sùntara* orange may have been already naturalised on the eastern border, it may not have reached *Western India*. Even at this day, although it is semi-wild in the east of India, it is scarce in the west. For similar reasons, both the Romans and Hebrews may not have got it. Its extensive and

semi-wild existence on the eastern border certainly does not indicate a very recent introduction.

As to its Sanskrit name, I have made great efforts to ascertain whether the words *nàrang*, or *naràngl i*, and *sùntara* may be of indigenous or Sanskrit origin, but from the chapter on "Derivations of Native Names of Citrus," it will be seen that this question is pretty much where it was, that is, not *satisfactorily* solved.* In the appendix and chapter on derivations, I have given every information that I have been able to collect on this subject, for the benefit of future investigators, as the derivation of native names may throw some light on the source from which the various kinds of citrus now in India came. Suffice it to say that the *sùntara* orange appears to have been known on the eastern border from pre-historic times. Whether it came from a distinct sour variety I am unable to say. This I know, that at the present day, there appear to be various sour varieties of this same *Sùntara* type, viz.: those called *kumquat*, *hazára*, and *surkh nimboo*, and not improbably Sir J. Hooker may have come across some of these, and which he describes as "a small slender tree, in the very bottom of valleys, along the foot of the Himalayas, from Gurhwal to the Khasia Hills, with fruit about two inches in diameter, uneatable, mawkish, and bitter." This type of orange is shown in pls. 93 to 116A.

It should not be forgotten also that certain animals, especially parrots, are fond of the citrus pulp whether sweet or sour, and are quite equal to carrying its seeds to long distances. Moreover the flavour of the orange pulp is liable to great change, according to soil, climate, &c.

* Perhaps Rumphius may again help us by his mentioning the *seng-cam* of China.

Taking everything into consideration, including the information collected from Rumphius's "Flora Amboin.," it is not improbable that the *sùntara* orange also had its cradle in southern China; but as the distinctive name *Sinense* is already applied to the *Portugal* type of sweet orange, it would be well to distinguish this by some other appellation to prevent further confusion.

CHAPTER VI.

THE KEONLA* AND MANDARIN GROUP OF ORANGES.

THESE varieties of oranges, with others, are much allied to the *sùntara* race. They are totally different from the Portugal orange type. Although in Upper India natives make a distinction between a *sùntara* and a *keonla* orange, the Bengalis call the *sùntara* of Sylhet *kàmlah lemboo.* Then, although *naránghi* is a generic name for oranges in general, there is a variety, belonging I think to this group, which natives call *naránghi* proper; others call it *narìnghi.* But there is so much confusion in the names of the Citrus in India that, as a rule, no reliance can be placed on vernacular names as affording distinctive characters. Then in Ceylon they have the mandarin proper, but in the markets *all* the *sùntaras* are called *mandarin oranges.*

Although there may perhaps be varieties which may be considered as on debateable ground, the *keonla* orange is quite different from the *sùntara.* The leaves of the *keonla* have a different scent, which when once recognized is not to be mistaken. Moreover the shape of the leaf is generally different, distinctly crenated and not pointed, but usually emarginate, as shown in pl. 124, figs. *c* and *d.* The principal difference, however, is in the fruit. When ripe, it is

* *Keonla* or *kanwla* are only corruptions of *kàmala.*

chagrined and much redder than a *sùntara,* and unless over-ripe it is so sour that it is almost uneatable. Natives don't think much of it, except for keeping after all other kinds have gone out of season. They either keep it for a long time on the tree till it sweetens, or collect it and keep it in its cut state until it becomes sweet. It is usually a very good cropper.

There are many varieties of *keonla* in different parts of India. Whenever I could get the leaf also it was not difficult to group a specimen ; otherwise I have had to rely on the name given to it, which is often deceptive ; or on the greater redness of the exterior, which is more of a lobster red than of a yellow orange.

The distinction of one kind by the name of *narìnghi* is not of much value. It may be a variety that sweetens *earlier* than the *keonla* proper. It is, however, rarely found in the markets by this name, but only in collections in native gardens.

In the Saharunpore Botanic garden, and in the Delhi public garden, I came across a variety called *kokni,* shown in pl. 127. The skin is very oily and strongly aromatic, and the leaf has more of the *keonla* scent than any other. It is redder than the *kumquat,* which never sweetens, while the *kokni* becomes sweet. It is not common, and I have met with it only in these two places.*

Another variety is that called *rèshmi,* shown in pl. 122, figs. *a* and *e.* This name is sometimes given to that called *hazàra,* which latter is either the *kumquat* itself, or an enlarged variety of it. The *rèshmi* is a very curious orange. The typical form is very flat, and with many folds, not unlike a tomato.

* In Rumphius, under aur. verrucosum, occurs a very small sweet orange from Madura, aur. pumilum Madurense. It may be this.—*Vide* Appendix 41 (*m*).

Its apex or distal end is often so red that it is not unlike the colour of a red tomato. It sweetens late and is not very juicy. Its leaves have the *keonla* scent. It is not common and only found in collections in native gardens. In Kandy they called it *heen-nárun.*

The Mandarin orange proper, I think, belongs to this group, but is a totally *distinct* orange. I believe it to be the same that Risso called *Bigaradier à feuille de myrte.* Its exterior is so shiny that it looks as if it had been varnished. Pl. 116(A) is taken from the Flor. Amboin., of Rumphius. He calls it *Aurantium sinense.* His description of it coincides with that of the *sùntara* orange of India. Loureiro refers to this plate under the name of *Citrus nobilis,* and De Candolle, under the name of Mandarin, gives Loureiro's botanical designation. Loureiro, however says that his C. nobilis agrees most with the A. sinense of Rumphius, but even this, he says, does *not coincide* with his description of C. nobilis.

A. de Candolle, regarding this variety, says " This species, characterized by its smaller fruit, uneven on the surface, spherical, but flattened at the top, and of a peculiar flavour, is now prized in Europe, as it has been from the earliest times in China, and Cochin China. The Chinese call it *kan.** Rumphius had seen it cultivated in all the Sunda islands, and says that it was introduced thither from China, but it had not spread into India. Roxburgh and Sir J. Hooker do not mention it, but Clarke informs me that its culture has been greatly extended in the district of Khasia. It was new to European gardeners at the beginning of the present century, when Andrews published a good illustration of it in the " Botanist's

* Rumphius says the *generic* name of the orange in Chinese is *kam.*

Repository" (pl. 608, vol. 10.)—(*Vide* note at the end this chapter, p. 57.)

It would appear that two distinct things are here mixed up. The one alluded to by Rumphius appears to be a *sùntara* proper, and the one extensively grown in the Khasia hills is also a *sùntara* proper, although not having seen all the varieties grown on those hills, I cannot say whether they have there also the true mandarin. However, had they it to any extent, it would certainly have found its way to the Calcutta market.

In Lucknow in 1863 I introduced the mandarin orange, together with the Malta orange and lemon, and from there it has been distributed to many other places. Neither at Lucknow nor at Etawah does this variety do well. The Mandarin tree is very delicate, and although the *sùntara* of Sylhet and of Nagpore, and the *keonla* do well there, this choice variety (mandarin) is half killed every year by the hot winds, and its fruit when unripe is very sour, and when ripe almost juiceless, so different from its delicious fruit when grown in a suitable climate and soil.

In Ceylon I found the true mandarin in the Peradeniya Botanic Garden. Dr. Trimen informed me that, in 1847, H.H. Ibrahim Pasha of Egypt, sent a collection of orange plants to Peradeniya, and that probably this true mandarin may have come there with that collection. Both the scent of its leaf and that of its rind, were unmistakably those of a true mandarin. I did not, however, see it anywhere out of Peradeniya, and the oranges in the Colombo and Kandy markets, which go by the name of mandarins, are only varieties of the *sùntara* and *keonla* oranges, and not *true mandarins.* The solitary fruit I found on a tree at Peradeniya was good, and probably this

variety would suit the Ceylon climate, if it were taken up by planters. There may be many other parts of India, free from too much cold, and from hot winds, which might also suit this choice orange. I don't know whether it has ever been tried in the Central Provinces, the black soil of that country might suit it. There are some varieties of oranges which suffer much by change of climate and soil, others don't change, and lastly, others vastly improve.

The leaves of the mandarin are the smallest I know. Some branches are covered with leaves not larger than those of myrtle. Its typical leaf is pointed and more like that of a *sùntara*, and hardly ever so emarginate, or crenate, as those of the *keonla* orange; their scent, however, is *sui generis*, and when once tried, can be recognized again by the same person with his eyes shut. The scent of the rind and the flavour of the pulp, in a perfect fruit, such as those found in English markets, are also very distinct. The fruit also of the mandarin can be recognized by its scent and flavour alone.

(*Nota bene*, I have looked at the illustration of the *Citrus nobilis*—mandarin—mentioned by De Candolle, as given in Andrews' "Botanist's Repository," pl. 608, British Museum. I was startled to find it called mandarin. It does not in the least resemble the mandarin orange tree, neither in leaf, flower, nor fruit. The leaves, as given in the plate, are immense, and nothing like those of the mandarin orange known in Europe and India. Then the colour of the fruit is given as an orange-*brown*. Admitting that the illustration may have become discoloured by time, although all the others appeared to have retained their brilliant colouring, then even the size of some of the fruit is enormous. It does not correspond to any

mandarin in commerce, or to any which I have seen. The true mandarin is noted for the *smallness* of its leaves, what Andrews' citrus can be I do not know. The only other illustration of citrus in the Repository is that of a Bergamot, which is like one, and therefore, it is presumable, the illustration in question must be like the one which Andrews, or his artist painted; but it is very different from a true mandarin, as we know it now.

In the "Botanical Register," vol. 3, 211, I came across a mandarin orange, which looks more like the real thing. Its fruit is pictured about 2¼ inches in diameter, and its leaves are more like those of pl. 117, fig. *c*, and pl. 118, figs. *c* and *h* of the Atlas. The "Botanical Register" adds that this is "the variety *minor*, and that in Andrews' "Repository," 608, the variety *major* is given, which sometimes has a diameter of five inches, and is of a deep saffron colour, and flattened." Both varieties were introduced into England by Sir Abraham Hume. The *làroo* of Poona has a very wide and flattened fruit, as seen in pl. 126, figs. *a* and *b*. (Can this *làroo* be any connection of the variety *major* mentioned above?)

In Baber's memoirs (Appendix, No. 1 (*h*)) in a note by Humayoon, the *kàmilah* is only mentioned, as "growing to the size of an orange; many hold it to be the larger lemon, but it is much pleasanter than the lemon. It has not an elegant appearance or shape." Nothing can be made of these few lines, but Humayoon was evidently alluding to some citrus which was sour, much like our modern *keonla*. He mentions the *sùntara* also, by the name of *sàmtereh*, and says there is no pleasanter fruit than the latter. It would appear that in Humayoon's time, both these were known in Bengal.

It should be here noted that Baber mentions a "sèngtera," which the translators call *common orange vide* Appendix No. 1 (*d*). Not much can be made of Baber's description. He says it is like an orange in colour, like a smooth citron in shape, and acid. This would correspond more with the *khatta*, and probably that was the reason why the translators thought it the *common* orange (?).

The *keonla* and *mandarin* group are given in pls. 117 to 128.

CHAPTER VII.

THE JAMBHÌRI GROUP.

NATIVES of India give this name in different ways, as *jamir*, *jamiri*, *jambhìri*, or *jambira*, and also *zamiri*. Although by some, *limes* proper are mixed up with this group, it is mostly a citrus with rather orange characters, such as are shown in pls. 131 and 132, which goes by this name. Even in the days of Baber it was *this* particular group, it appears, which went by the name of *jambiri*. He says in his memoirs, that the *jambiri* is an acid citrus, of a deep yellow colour, "resembling an orange, but which is not an orange."

From a commercial point of view it is not in demand, and, therefore, it is mostly found in gardens of native collectors of fruit trees, and grown more as a curiosity. From a natural history point of view, however, I think it a very interesting group of citrus.

The general character of the fruit and foliage is that of the *keonla* and *sùntara* oranges. The flowers I have not seen, excepting in that of Hagkala. The exterior of the fruit varies from smooth to chagrined and subwarty. It is mostly mammillate. The colour of the rind is either lemon-yellow or orange colour. Some have a curious *fawn*-coloured epidermis, like that of a potato. Whether this is an excretion formed by some insect or not, I do not know. I have not, however,

seen it in any other type.* The colour of the pulp varies from white to pale with an orange tinge, and to orange. All are sour, and never sweeten, and the internal arrangement of the pulp is like that of a *keonla* or *sùntara* orange. The leaves I have seen resemble mainly those of the *keonla* group, excepting that of pl. 136 from Hagkala in Ceylon. Some of the leaves of this were enormous. This may be owing to climate and excessive moisture, or to their growing on young luxuriant shoots. Several kinds of citrus on the young shoots, which grow from the base of the stem, often produce unusually large leaves. The flowers and young shoots of this Hagkala tree were tinged purple, and the pulp pale orange.

Whether this group has any connection, by descent, with the *keonla* group of oranges or not, it is impossible to say. Direct experiments in crossing the different varieties of citrus may possibly throw some light on this point.

Many authors give this name of *jambhìri* as of Sanskrit origin, and, therefore, conclude that it is *indigenous* to India. Others deny that any genuine Sanskrit work makes *any* mention of *any* citrus whatever.† Supposing, however, that some Sanskrit work did mention the *jambhìri*, it is next to impossible to make out which of the many Indian varieties of citrus is meant. Brandis gives the lime proper, the *kaghzi-nimboo*, the Sanskrit name of *jambira*, but natives give this name mostly to the forms on the plates mentioned, which are *not* those of the *kaghzi-nimboo*. Moreover, it is doubtful whether the lime proper is

* In another place I mention that a South American gentleman informed me that in Monte Video they have good oranges, which are *brown* externally, like the brown apples of the English shops.

† *Vide* Chapter on "Derivations of Citrus Names."

indigenous. In addition, English writers have often given the name of *lime* to citrons, lemons, sweet lemons, sour oranges, &c., so that it is impossible to make out what is really meant. In this work by lime proper is always meant the *kaghzi-nimboo* and its varieties, which corresponds to the Montserrat lime, and to the *Limonellus* or *Limo tenuis* of Rumphius.

What I consider specimens belonging to the group of Baber's *jambiri* are given in pls. 129 to 138.

CHAPTER VIII.

THE CITRON GROUP.

THE Emperor Baber in his memoirs, under the heading of "taranj," says that "the inhabitants of Bajour and Siwàd call it 'baleng.' On this account marmalades of citron peel are called 'baleng-marmalades.' The Hindostanis call the 'taranj,' the 'bajouri.' It is of two species: one is insipid and sweet, but of a sickly sweet, and is of no value for eating, but its peel is used for marmalade. The citrons of Lemghanât are all of this sickly sweet. The other kind is the citron of Hindostan and Bajour, which is acid, and its sherbet is very pleasant and tasteful. . . . Its skin is rough, rising and falling in knobs. Its extremity is thin and knobbed."

In Mangalore the citron is called "mauling," and it is not impossible that this is only a transformation of the "baleng" of Baber, or *vice versâ*. The Arabs were among the oldest traders on the western coast of India, and the modern Malabari Moormen of that coast are probably descendants of those Arabs.

Sanskrit scholars say that the word *bajoura* comes from the Sanskrit *bíja-pùre*, "full of seeds," which both the *turunj* and the *bajoura* of India often are. But from Baber's memoirs, it would appear probable that the "bajoura" is so named after Bajour, a district on the N.W. frontier.*

* *Vide* Appendix, No. 1 (*c*)

Some natives consider the *turunj* and the *bajoura* as one and the same thing. But mostly natives call the real citron *turunj*, and an intermediate form between this and the lemon *bajoura* (a sort of citron-lemon).

In Kandy the citron by some is called *nàtterun*, by others *sìderun*.

In Concani, I am informed, it is called *mauling*, and in Tulu, *mâpala*.

Mr. A. Y. Gubboy informed me that, in Hebrew, the citron is called *etrog*; in Arabic, *turunj*; and in Bengali, *shutrunj*. By another gentleman I was informed that *turunj* is a corruption of the Arabic word *utruj*, and means a lemon. *Utruj* and *atrog*, or *etrog*, however, have a family resemblance.

Sir J. Hooker, under the heading of "Citrus Medica, Linn.," states: "Young shoots glabrous, purple, leaflet glabrous, flowers often unisexual,* petals generally more or less pink, fruit globose, ovoid, or oblong, often mammillate at the apex. Found in the valleys along the foot of the Himalayas, from Gurhwal to Sikkim, ascending to 4,000 ft.; the Khasia mts., Garrow mts. (Roxburgh), Chittagong (H. f. and T.), and the Western Ghâts, and Satpura range in Central India."

"A shrub or small tree, flowering and fruiting at most seasons, growing where I found it, on steep hill-sides (in Sikkim). Leaflet 3 to 6 in., elliptic-ovate, or ovate-lanceolate; petiole naked, or winged. Flowers 5 to 10 in a raceme, small, or middle-sized. Stamens 20 to 40." Then follow the varieties, which, he thinks, have originated from the *C. medica*, Linn., of which, he says, he found "one truly wild in Sikkim, with an oblong leaflet 4 in. long, margined petiole, pink flowers 1 in. long, narrowly ellipsoid rough fruit, 6 in. long,

* I have found most citrus with male and hermaphrodite flowers.

of which the upper 2 ins. are contracted into a long conical mammilla; the rind is very thick, and pulp pale yellow. The petals pass into stamens, which would suggest its not being indigenous; but I did not doubt its being so when I gathered it, mainly on dry sunny slopes, totally unsuited for any kind of cultivation, where it formed large bushes."

Of course, when a botanist says he found a certain plant *wild* in a certain place, he probably does not mean that it has been there from the beginning of time, or even from the very commencement of the citrus family on this earth. The site where Sir J. Hooker found this wild citrus may have been the scene of many previous changes, not only geological and meteorological, but also those produced by human agency. It may have been the scene of invasions, and destruction by fire, and of subsequent new forest growth; it may have been the scene of peaceful clearings for villages, &c. In those days I fancy villages were very primitive—such as might be made of wood, leaves, and perishable materials. If the tribes happened to be nomadic, and the site was abandoned, in a very short time the place would become reforested, and not a trace of such perishable materials would remain. We can rarely know to what extent man and other animals may have aided in carrying seeds of plants from place to place. Who can tell what part parrots, especially, have played in disseminating citrus seed, carried with the pulp to their nests for their young, and dropping it on their way in various places?

Therefore, in most cases, it is next to impossible to decide, whenever a citrus is found wild anywhere, whether it was there, or in the vicinity, from the

beginning of its family history, or whether it became naturalized there through the aid of birds, &c.

From the description of the variety Sir J. Hooker found wild in Sikkim, it would appear that it had already gone through a considerable amount of selection ; but whether this had been naturally effected, or artificially by the aid of man, it is impossible to say. It should be remembered that the citrus fruit, whether red or yellow, would have been a very prominent object among the green foliage, and would therefore have attracted attention very early in the history of man. From the description of this wild citrus, I gather that it was neither more nor less than a fully developed *turunj*—a citron scarcely differing from some now found in cultivation.*

The first variety of the *Citrus medica* described by Sir J. Hooker is: "Var. 1, *C. medica proper;* leaflet oblong, petiole short, margined or not, flowers usually numerous, fruit large, oblong, or ovoid, mammilla obtuse, rind usually warted, thick, tender, aromatic ; pulp scanty, sub-acid."—Synonyms. "Brandis, For. Flor. 52, *C. aurantium*, var. *medica;* W. & A. Prodr. 98, *C. medica*, Linn. ; Wall. Cat. 6387; Dalz. and Gibs., Bomb. Fl. Suppl. 13—The Citron."

From a large number of citrus which I have examined, I would think that the whole series, descended probably from the *Citrus medica*, may be, perhaps, more naturally divisible into the following branches, although, of course, one runs into the other :—

1. *C. medica proper* (Citrons proper).	*a.* Chhángurá (or primitive citron).
	b. Turunj.
	c. Madhkunkur.

* *Vide* Appendix, No. 44.

2. *C. medica,* var. *Bajoura.*	*a.* Lemon-citrons. *b.* Citron-lemons.
3. *C. medica,* var. *limonum* (Lemons proper).	*a. C. limonum vulgaris* of Risso (Malta, Italian, and Portugal lemons, and varieties). *b.* Nepal lemons. *c.* Sweet lemons (not limes). *C. Lumia* of Risso.
4. *C. medica,* var. Pummelo-lemons.	*a.* Sadáphal. *b.* Attárra.

N.B.—It is doubtful whether the latter (No. 4) ought to be included in this group.

For reasons stated elsewhere, I thought it better to exclude from the *C. medica* group the true limes (*C. acida* of Roxburgh).

From the citron proper to the lemon proper I have found many gradations or intermediate forms, so that the relationship is not difficult to trace. The most useful, however, appears to be that form which, in the hands of the cultivators of the south of Europe, combined all the best qualities of a sour citrus, viz., very aromatic and not too thick-skinned; neither too large, nor too small a fruit; abundant and pure acid juice; and ease of propagation and cultivation. It contains all the good qualities in one fruit, making it the most desirable variety for general cultivation; hence its vulgarization, which, in other words, means that it became very common. A good thing is always in demand, and sooner or later it must become very common, if it admit of easy propagation and cultivation. This variety is the *Citrus limonum vulgaris* of Risso, the sour lemon of Europe, and may be some

smaller varieties of lemon of India. The French still call this lemon "citron."

In the foregoing attempt at the classification of the *C. medica* I have put the *chángurá* first, because if it is not the same pre-adamite citron continued to our days, it is, in my opinion, probably a reversion of some cultivated form to an ancestral type; that is, to a form in which, according to my view, there had not yet been developed a regular juice pulp, but instead of it an inner whorl of rind. From the latter, as I have ventured to explain in the chapter on Morphology, the whorl of carpels, containing the juice vesicles, may subsequently have become developed.

This *Chángurá*, or primitive form of citron, is shown in plate 139, fig. *a*, and plate 140, fig. *a*. Its leaves (that is, those sent with it) resemble more those of a citron than those of a lemon.

I found that, practically, natives made a distinction between the *turunj* and the *bajoura*. The larger specimens, shown in plates from 142 to 147, and others, they call *turunj*. Their pulp is usually sour and dry. Their skin is very thick, giving the pulp an insignificant position. The white part of the skin is of a carroty consistence, and sweet. Not improbably these large *turunj* may have been selected, and their skin thickened, as an article of food, on account of its sweetness, while the pulp in these may have been looked upon as of secondary importance. The leaves of the *turunj* proper are usually oblong, and often deeply emarginate, as shown in plate 155, figs. *c*, *d*, *e*. They have a short petiole, with its wings often continuous with the blade of the leaflet, with, or without a distinct joint between the petiole and the leaflet. The edges of their leaves are oftener serrate than crenate.

The *bajoura* on the contrary, has a thinner skin, and a much larger pulp, with abundant acid juice. Its leaves usually resemble more those of the lemon than those of the citron proper, like those in plate 161, figs. *c*, *d*, and *e*.

Natives also make a distinction between the *turunj* and the *madhkankur*. The latter name appears to be of Sanskrit origin, but may be of recent application and a mere translation of the sweet melon-like character of the fruit.

I may mention that many natives consider the *bajoura* as the real *sui-gul* of tradition, or needle melter. This would indicate that its juice is very acid and abundant. It is, not improbably, an intermediate form between the sour citron and sour lemon. Specimens of the *bajoura* are shown in plates 159 to 162, &c., while those of the *madhkankur* are shown in plates 171 and 173, and others.

From Nepal I received a citron under the name of *bhímra*. I am informed that "Bhím" is the Hindoo Hercules. Although this specimen was small, it may have come from a tree bearing also huge citrons.

To recapitulate, then: under the head of *Citrus medica*, we appear to have the primitive and pulpless *chángurá*; the uncivilized *turunj*, *madhkankur*, and others; the semi-civilized *bajoura*, and the thoroughly civilized group of lemons. I have used the term "civilized" intentionally. The association of the different stages of this interesting group with man would, I think, indicate that in his uncivilized state he cared little about the pulp, and only wanted something large, solid, and sweetish, to fill his stomach with, and satisfy his hunger, without much consideration of choiceness of flavour; the intermediate stage would indicate that man had begun to appreciate an acid juice

either for quenching thirst in sickness, or for other purposes in the arts and cookery. Finally, the lemon stage would appear to indicate a largely extended use of an abundant acid juice for the various purposes of civilized life, and that man had ceased to encourage much any great thickness in the skin, the latter becoming now a much less important part of the fruit.

The specimens of citron represented in plates from 142 to 148 I obtained from the Bombay market, and I was told they came from the places mentioned. By Bassein is meant the place of that name near Bombay. With the experience gained from the fruit of the *khatta* orange, as shown in plate 29 and others, one need be careful in accepting all these forms as products of distinct trees. Unless the fruit has been seen on the tree, and in different seasons, it is impossible to say whether two or more of these Bombay market citrons may not have been the produce of one and the same tree.

After having read all that has been said regarding the origin of the *C. medica*, and its derivatives, I am still in doubt whether it is indigenous in India. It does not appear to have any ancient Sanskrit name, and the number of varieties, if they are varieties, on the western sea-coast is suggestive. It is curious that they should be found on the area which came most in contact with foreigners. The huge sweet variety of Almora may have been easily introduced from "Lemghanât" on the Afghan border, and become further improved by acclimatization in that genial moist clime.

It has been stated that the *Citrus medica proper*—the citron—had already reached Italy from Media, about the third or fourth century, and that the Jews

used its fruit in the Feast of Tabernacles. Now, in South India, near Cochin, there is a Jewish colony, established there, it is said, since 490 A.D. The Jews, in their own country, in Western Asia, must have used the citron in their Feast long before this date, and therefore, it is not improbable that the Jewish colony, when they emigrated to South India, took the citron with them, and sowed its seed in their new home ; it is a fruit which keeps long without spoiling. Nevertheless, if India ever possessed an indigenous citrus, it is probably the *C. medica proper.*

If the reader will turn to Appendix, No. 58, he will see that the *chángurá* citron—what I call the primitive form of citrus—was well known in China. From the use the Chinese made of it, it would appear that it was not only an occasional monstrosity, produced on an ordinary citron tree, but probably a variety that always produced that form of fruit. Its rarity may have been due to the impossibility of reproducing it from seed, as it probably had none. About two hundred years ago, according to Rumphius, the Chinese inhabitants of the Malay archipelago did not know the art of budding or grafting, although they appear to have been acquainted with a mode of layering. This, therefore, may explain the rarity of the fingered citron in China, as stated in the appendix above mentioned. We know, moreover, that not only Orientals, but civilized Europeans also, dislike the idea that a rare thing they may possess should become common.

Whether the citron had its cradle originally in China, like most other citrus, and came to India afterwards, or *vice versâ*, it is perhaps impossible now to make out. That in ancient times, and especially in Buddhistic times, there had been intercourse between China and

India across what is now the north-eastern frontier, is very probable, and this might explain, supposing the *Citrus medica* also to have been introduced from China, how it came to be wild in many places along the north-eastern border of India. It would explain also the fact of there being so many varieties of citrus along that border.

Note.—In the "Babylonian and Oriental Record" for May, June, and July, 1888, in an article on the "Cone-fruit of the Assyrian monuments," I have endeavoured to show that it is possible this "cone-fruit" may have been intended for a *citron*, and not for a *pine-cone*, as Assyriologists had supposed. Moreover, in the same Record for July, 1888, Prof. Dr. T. De Lacouperie has stated that he has traced communications between Mesopotamia and North China as early as the twenty-third century B.C.

Figures of the citron group are given in pls. 139 to 177.

CHAPTER IX.

LEMON GROUP.

THE Lemon-group is, properly speaking, a continuation of the Citron-group.

In Baber's memoirs there is mention of the *limoo*,* and by this the translators thought the *true lime* was meant. It is impossible to say which kind Baber really meant. In Bengal every Citrus is called *lemboo*. In Upper India many varieties go by the name of *nimboo*. Some, however, pronounce it *limboo*. Had the true lime, or *kaghzi nimboo*, been known to Baber, he would probably have written its name as *kaghzi limoo* had it then been known by that name.

In the same memoirs mention is also made of the *kilkil*,† as the translators have called it. This *kilkil* gave me some trouble to trace. All the natives I asked about this Citrus said they never heard of any kind called *kilkil*. On one occasion I happened to ask a subordinate of mine whether he ever heard of it. He said I have not heard of *kilkil*, but I have heard of *gulgul*. Another native standing by then showed me how easy it is in the native character for *kaf* to be changed into *gaf* by the addition of a simple line. New light then began to dawn upon me. One day I asked a native scholar whether the alphabet of the Jaghatai Turki, in which Baber wrote his memoirs,

* Appendix, No. 1 (*b*). † Appendix, No. 1 (*e*).

had any *g hard* in it. He said, no. I then came to the following conclusion :—Baber, writing in a language which had no *gaf* wrote the name of the lemon "gulgul"—*kulkul.* Of course the short vowels are omitted, and he wrote *klkl.* This might be interpreted either as *kulkul* or *kilkil.* The translators, probably not knowing this kind of lemon, read it *kilkil.* It is a very large lemon, and the Punjab *gulgul,* shown on pl. 186, figs. *e* and *f,* corresponds almost exactly with that described by Baber, viz. : "In shape it is like a goose's egg, but does not, like the egg, taper away at the two extremities. The skin of this species is smooth like that of the *sengtereh.* It has a remarkable quantity of juice."

Another lemon mentioned by Baber is the *amratphàl** or sweet lemon, which moderns universally call *shèrbetee.* They say that the latter name, the *amratphàl* and the *mitha nimboo,* all mean one, and the same variety, the sweet lemon, and which is mostly called *sweet lime.* Under the heading of *amratphàl* the translators of these memoirs state that Humayoon said that "Its juice, though not extremely sweet, yet is very pleasant. Its acidity when unripe resembles that of the orange. While yet very acid its sourness affects the stomach, but in course of time it ripens and becomes sweet."

I have a suspicion that Humayoon made some mistake. The *amratphàl* or *shèrbetee* is *acidless* from *beginning to end.* I have not been able to find that any native knows of any kind of *shèrbetee* lemon,† which is *acid* when unripe, and *sweet* when ripe. The young unripe *shèrbetee* I tasted was as sweet or as acidless

* Appendix, No. 1 (*h*).

† From Calcutta a *sour* Citrus came ticketed *sherbetee pati.*—(*Vide* pl. 207, figs. *i* and *j.*)

as the ripe one. Probably the following is the mistake Humayoon made :—The *kalan kaghzi nimboo*, shown on pl. 189, figs. *a*, *c*, and *e*, when ripe, is indistinguishable in all respects from the *sherbetee nimboo* shown on pl. 191, fig. *a*, except that the former is *sour*, while the latter is *sweet*. Both are globose thin-skinned lemons, and Humayoon may have tasted an unripe *kalan kaghzi* lemon, mistaking it for an unripe *amratphàl*.

The Pundits of Benares quote a much older work than Baber's memoirs, in which the Citrus is mentioned. This work is called *madanpàl nighùnt*—a Sanskrit book on medicine, written about the year 1354 A.D. and is therefore upwards of 500 years old. In it, they say, are mentioned *nimboo* and *raj-nimboo*. Which kinds are meant it is impossible to say, but by the latter name possibly some *large* variety, like the *gulgul*, may be meant.

Under the heading of Citrus Medica Limetta, Alph. de Candolle groups the C. limetta and C. lumia of Risso, and says that the only difference from the other varieties of C. medica is that it has spherical fruit and sweet, non-aromatic juice. There are, however, several sweet *citrons* proper, and they have been also referred to by Baber under the name of Lemghanât citrons. De Candolle also says that in India this Citrus is called the *sweet lime*. Wrongly so-called, I think, because it appears to me no other than a sweet *lemon*. He also says that " the botanist Wight affirms that this last variety is wild in the Nilgiri hills." (?)

Sir J. Hooker makes the sour lemon, var. 2, C. medica *limonum* ; and of the sweet lemon, var. 4, C. medica *limetta*, and includes in the latter the sweet lime and sweet lemon of Risso. Of the sour lemon, he says " leaflet ovate, petiole margined or winged,

fruit middle-sized, ovoid yellow mammillate, rind thin, pulp abundant, acid. *Synonyms.*—Brandis, l.c., 52 : C. aurantium var. limonum ; W. and A. Prodr. 98, C. limonum; Wall. Cat. 6,389; Dalz. and Gibs., Bomb. Fl. Suppl. 13 ; C. medica, Willd., according to Roxburgh, Fl. Ind. iii. 392—the lemon."

And of the sweet lemon, he says fruit globose, three to five in. diam., rind thin, smooth, juice abundant, sweet, not aromatic. " *Synonyms*—Brandis, l.c. 52, C. aurantium, vars. limetta and lumia W. and A. Prodr. 98 ; C. limetta of Risso, Dalz. and Gibs., Bomb. Fl. Suppl. 13., Wight, Ic. t. 958, Wall. cat. 6385."

Without seeing the tree, with its fruit at different seasons, and its flowers, and also the young tree grown from seed, it is not an easy matter to group the lemons of India, without a good deal of arbitrary placing. I have given in pls. 179 and 180, a number of outlines of the Malta lemon, to show how easily one or other of these forms might be taken for some other kind, unless one had *seen* them on the tree.

The following is an attempt to classify the lemons, but a much closer study of the whole group is required to do this satisfactorily. Each variety requires to be studied on the tree at different seasons, while in many cases, I had only the opportunity of seeing the fruit. When leaves were sent, the chances are they were taken at random, without regard to their being typical or not.

Lemons Proper.

(C. Medica, var. limonum.)

1. Digitate or primitive lemon.
2. (C. limonum vulgaris of Risso)—Malta lemon.

3. Round, thin skinned lemon } (*a*) Kalan Kaghzi—*sour.* (*b*) Shèrbetee—*sweet.**
4. "Gulgul" varieties.
5. Nepalee nimboo.
6. Gungolia.
7. Behàri.
8. Sadàphal } The position of these is doubtful.
9. Attàrra }

With regard to the sweet lemon, it is difficult to decide whether it should be classified among the lemons or among the oranges. All the sweet lemon trees I have seen had *pure white* flowers, and one of them had vastly more numerous *male* flowers than hermaphrodites. Most of them, however, are slightly mammillate, but there are mammillate oranges also.

The citrus limonum vulgaris of Risso has been recently introduced into India by several persons. The lemon shown on pl. 183 came from Mr. Stalkartt's garden at Goosery, near Calcutta. He says it has been there since 1833. Mr. Blechynden, secretary to the Agri-Hort. Society of India, says that it is probable the trees of this lemon, which they have in the Society's gardens, came from Goosery. He adds that Firminger alludes to this lemon, under the name of "Common Spanish," and gives its native Bengali name as *korna-nimboo.* He further says that in the Hortus Bengalensis of Roxburgh, the *korna-nimboo* is given as "Citrus Medica, common lemon," and the date of its introduction into the botanic gardens of Calcutta is given as 1796.†

* It is not impossible that the sweet lemon may have descended directly from the *sweet citron*, and the sour lemon from the *sour citron.*

† He does not, however, mention *where* it was introduced from. Possibly it may be an improved *jora tenga* of Assam, vide pl. 239.

I introduced the Malta lemon into Lucknow in 1863, together with other citrus. Thence it has been distributed to numerous places.*

Mr. Nickels, of Jaunpore, introduced this lemon tree from England in 1872. It is given in pl. 185.

At Pondicherry I found this lemon also, and, as I have not met with it anywhere else in South India, the chances are it was introduced there by the French. It is given in pl. 184, figs. *a* and *b*.

Is the petiole of the lemon leaf margined, or naked?

There were in Etawah upwards of 300 Malta lemon trees which I had propagated. In the petioles of *all* the margins had entirely disappeared, and it required a magnifying glass to discover the remnants of the margins in two slight elevations on the upper part of the petiole, which is short and yellow. I offered the native gardener four annas (sixpence) for a leaf with a margined or winged petiole, but among the 300 trees, he was not able to find one. This shows how fixed a character the *naked* petiole has become in this variety. I attribute its absence in all these trees to their all having been raised by *budding* from the original trees in Lucknow. I would not be sure, however, that the young leaves of its seedlings would not have margined petioles, losing them when the tree became adult, and its leaves perfected. Other varieties have margined petioles in their typical leaves.

The descriptions of the lemon plates in the Atlas give all I can further say on this important group. Their forms differ, perhaps, more than in other groups. The whole group requires to be studied more minutely, and experiments require to be made to ascertain how far its varieties may cross with each other. The seed-

* Recently also to Assam, Calcutta, Bangalore, Tinevelly, and the Punjaub.

ling forms, and the adult forms, grown under different conditions of soil and climate, would also require to be learnt, in order to obtain an accurate notion of their affinities. The specimens given on pls. nos. 209 to 214 do not, I think, belong to this group. The "Sadàphal" appears to be a distinct thing from all the rest. Some which I included in this group may not impossibly be varieties of the *lime proper*.

Pls. 178 to 224 give figures of this group.

CHAPTER X.

THE TRUE-LIME GROUP, AND THE "LIMA."

THE only statement in Baber's memoirs which might incline one to think that his *limoo* is the true-lime, is his qualifying it by "it is very plentiful."* The only Citrus which is now found all over India is the true-lime—the *kaghzi nimboo*—and its varieties.

According to Brandis, the Sanskrit name of the true lime (C. medica acida) was *jambira*. In my opinion the *jambiri* is a totally different Citrus, and owes its parentage to a different source from that of the true-lime. Both the word lime in English, and the *jambiri* in the vernacular, have been much abused, and have caused great confusion.

Sir J. Hooker, in his "Flora of British India," following Dr. Brandis, places the lime as a variety of the *Citrus medica*—the Citron. He says, under the heading of C. medica, Linn.: "Var. 3—*acida*—leaflet elliptic, oblong, petiole many times shorter than the leaflet, linear or obovate, racemes short, flowers small, petals usually four, fruit usually small, globose or ovoid, with a thick or thin rind, pulp pale, sharply acid," the same as C. acida of "Roxburgh's Flora Indica." The large fruited states of this Citrus appear to assume the form of Citron, and the small to ap-

* *Vide* Appendix, No. 1 (*b*).

proach the West Indian lime, which is, however, described as a bush with white flowers."

I have seen undoubted limes with purely white flowers, but usually the flowers are *slightly* tinged with purple. Wherever I have seen the *kaghzi nimboo* it was always a good-sized bush. I have never heard that it is propagated by budding, but always by seed, and it flowers in about four or five years.

I do not think that much reliance can be placed, for purposes of classification, on either the colour of the petals or that of the young shoots. I have seen young lime shoots more or less deeply tinged. Sometimes they only have a slight tinge of ochre. I have seen the young shoots of the Séville orange, the *khàtta* orange, and the pummelo having the same tinge; and I have seen a citron with white flowers and green young shoots.

Besides the smallness of the fruit, in the true-lime there is a character which is very constant in typical leaves—I mean their winged petioles.

Were I inclined to give great weight to the doctrine of reversion, I would urge that, as the lime tree is always raised from seed, it would have had ample opportunities for its foliage to revert sometimes to its supposed ancestral forms—that of the lemon and citron; but it never does this, as far as I have seen. Its foliage has a stamp which is very different from that of either the lemon or the citron proper.

In Ceylon, one day, I asked Dr. Trimen to be good enough to show me what he had in the way of Citrus trees in the Royal Botanic Garden of Peradeniya. While going over the ground, his foreman placed in my hand a Citrus fruit which I had never seen before, and which he said he had brought from an adjoining cocoa plantation. In Ceylon this Citrus is called

lima, or *kùdalu dèhi* (leech-lime), and also Caffre-lime, by the Europeans.

It then flashed across my mind that possibly I held in my hand the wild form of *all the cultivated true-limes.* Dr. Trimen and myself then visited the tree together. The immense winged petioles of this *lima* rather staggered me. The spines, large and small, the leaflet and the flowers, were those of the cultivated forms of lime. I collected some small leaves of this interesting Citrus, and compared them with the *well-developed* leaves of an adjoining *cultivated* lime tree, and found that the undeveloped petiole of the "lima" corresponded with the fully developed petiole of the lime (see pl. 225, figs. *h*, *i* and *j*). The lime leaves are thinner, and so is the skin of the fruit. Thin leaf and thin skin, or the reverse, usually go together, though not always.

I afterwards learnt that this "lima" is never eaten; that it is used, boiled, as an insecticide for washing the head; that it is used by estate coolies, and others, for smearing over their feet, as an antidote against land-leeches, and hence its acquired name of "kùdalu dèhi," or leech-lime; that it is often grown near villages, and is sometimes found in jungles. This "lima" appeared to me to have the characters of a wild species. Its fruit is warty and thick skinned; the rind has an aromatic *resinous* scent and a bitter acrid flavour. Its essential oil tinges paper permanently of a gamboge-yellow. The pulp is sour and of an unpleasant taste. A riper specimen of this fruit, which I afterwards obtained, had an aroma *sui generis* in its *greenish* pulp, not unlike that of the true-lime, although mixed up with unpleasant flavours. It appeared to me much less common in Ceylon* than

* Dr. Trimen has recently informed me that he found it common about villages.

the cultivated limes. I could never find it in the markets either in Kandy or Colombo. In the former place I offered eight annas for a ripe specimen, and did not get it. In Colombo I offered four annas for one. There was none in the market, and I only got one next day from some village. Of cultivated limes I could get any number of ripe fruits. Pl. 225 gives outline drawings, drawn to scale, of both the fruit and foliage of this *lima.* Figs. *h* and *i* are *lima* leaves, and fig. *j* is a true-lime leaf, given for comparison. The petioles of *h* and *j* are identical.

By the courtesy of Dr. Trimen I had the opportunity of looking over Rumphius's "Flora of Amboyna." I found that this Ceylon *lima* had the characters of his *Limo ventricosus,** vol. ii. tab. 26, fig. 1. Making allowance for his artist's inaccuracies, I think the two are one thing; the flowers are pictured with four petals, and he says "*it is used for washing the head.*"

Before going any further, I should mention that later on I obtained, through the kindness of Dr. King, another copy of Rumphius, from the library of the Botanic Garden of Seebpore, near Calcutta. It possessed the great advantage that on the back of each plate it had comments by Buchanan Hamilton *in his own hand-writing.* I have now seen three copies of Rumphius's "Flora of Amboyna," including that of the British Museum. All three have the same mistake, on tab. 26, figs. 1 and 2, vol. ii. Somehow, either by an oversight of Rumphius himself, or of his editor, Burmann, in the *Explicatio,* these two figures have been reversed. In the letter-press, the description of *Limo tuberosus martinicus* corresponds with fig. 2 (and not with fig. 1, as is given in the *Explicatio*), the latter

* Not *tuberosus.* The numbers in the Explicatio of this plate are by mistake reversed. *Vide* N.B. at end of (*c*) Appendix, No. 41.

having a *totally different foliage.* Again, the description of *Limo ventricosus* corresponds with fig. 1, and not with fig. 2, as given in the *Explicatio.* Buchanan Hamilton, in the copy referred to, had noticed this mistake, and on the back of the plate wrote the figures with the right names they ought to have borne, according to the descriptions, viz.:

Fig. 1. *Limo ventricosus.*
Fig. 2. *Limo tuberosus martinicus.*

The latter has the naked petiole of a *lemon,* and the former the large-winged petiole of the *lima.*

There is yet, I think, another mistake in this same plate. The *Explicatio* says, fig. 3 is a branch of the *limo ferus.* Now *limo ferus* appears to be altogether a different thing, and fig. 3, in my opinion, is no other than a *smooth form* of fig. 1.* Their foliage is identical, while the *limo ferus* is different both in fruit and foliage (?). I have given an outline of the latter in pl. 226, fig. *c,* and in Rumphius it is shown more completely in tab. 28, vol. ii.

I also found that in Rumphius there was a series of citrus with large-winged petioles. It appeared to me probable that they were all more or less connected with Limo ventricosus. Some had less tubercled exteriors, and some very small fruit, even smaller than that of the true lime, yet retaining their large-winged petioles. Outlines of these are shown in the accompanying Atlas in pl. 226, fig. *b, Limo agrestis ;* pl. 226, fig. *c, Limo ferus ;* pl. 227, figs. *c c, Limonellus aurarius.* Finally, we have in pl. 227, fig. *e,* the *Limo tenuis* (shown in Rumphius on tab. 29, vol. ii.). This is the most important of all. It corresponds both in picture and description with the *true lime* of Ceylon, India, and

* *Vide* pl. 227, fig. *a.*

Montserrat. Judging from its flowers, spines, and form of leaflet, it appears to be related to the series with *large-winged* petioles, and, perhaps, the reason why I have invariably found the true lime with a winged petiole, though generally small, may possibly be its descent *from one with a much larger winged petiole.*

Some might say, if so, why do we never find any reversion in the lime to its ancestral *large winged petiole?* Perhaps this objection might be answered better by a series of questions. (*a*) If it is, as botanists say, that the true lime is a variety of Citrus medica, why does it never revert to the petioles and leaves of the citron, which are so different? (*b*) Why does man's internal tail never revert to the external tail of his progenitors, except in his embryonic state? (*c*) Why do birds never revert to their lizard-like ancestors? (*d*) Why does the horse never revert to his five-toed progenitor?

The only reply to all these and similar questions is, that there must be a limit to reversion. They probably do revert, when only recently emerged from their ancestral types, by some "break," as horticulturists call it; but continued selection, natural or artificial, for other *more useful and important characters*, apparently often *extinguishes* the power of reproducing certain other characters. This law can only be deduced from the fact that animals and plants *actually don't* go on reverting for ever to *all* the characters of their ancestors. If they *did*, there would hardly be any room for selection. It is only by the suppression of some character, or exaggeration of another, or evolution of some new one, that things can become different, and continued selection in any particular direction must, sooner or later, suppress or dwarf some of the least important or disadvantageous parts.

In my opinion, with every generation that passes *without* reversion, the power of reverting will become weaker, until it is entirely extinguished.

There is probably nothing in connection with the citrus better established than that it has descended from a progenitor with a compound leaf. The *Citrus trifoliata* plainly indicates this ; allied genera, the *Ægle marmelos*, the *Feronia elephantum*, and *Limonia acidissima* and others point in the same direction. Moreover, the almost universal joint between the leaflet and petiole of all the cultivated citrus (only absent in some leaves of some citrons, and the two first leaves of young citrus seedlings) prove it to have descended from an ancestor with a compound leaf. Nevertheless, of some hundreds of seeds of about fifty varieties of citrus that I have sown, only three produced a few leaves with a trifoliate character. These are shown in pl. 246, figs. *d*, *e*, *f* and *g*.

Is it, however, a fact that the petiole of the true lime never reverts to some ancestral and larger form ? In pl. 226, figs. *d*, *e*, *f* and *h*, I have given specimens of true lime leaves, with large wings to their petioles ; and in pl. 233, figs. *a* and *b*, I have given others taken from seedling trees about five years old.

I may as well note here that Loureiro's *Citrus limonum* ("Flor. Cochin Chin.") is given as a variety of *C. medica*, and he refers the reader to Rumphius's "Flora Amboyn.," vol. ii. tab. 29. Unfortunately this plate gives two very different things, viz.: fig. *a*, which I believe to be a *lemon* with unwinged petiole, and probably descended from C. medica ; and fig. *b*, a *true lime*, like the Indian kinds, and pictured with four petals. Rumphius says that on rare occasions the *a* form is produced, but he does not mention whether on the lime tree proper, or on a *totally different* tree.

After having exhausted Rumphius's interesting chapters on the citrus, I turned to Kurz's "Flora of British Burmah," and under the name of *Citrus hystrix*, D.C., *Shouk-poté*, I found the identical *lima* of Ceylon, and the *Limo ventricosus* of Rumphius, in what appears to be a wild state. If I were writing a description of the *lima* of Ceylon, I would take Kurz's C. hystrix. "It is armed with longer or shorter straight axillary spines ; all parts glabrous ; leaves oval or ovate, 1½ to 2, rarely 3 inches long ; unusually blunt or retuse, almost entire, or crenate, glabrous ; petiole 1-1½, often 2 or 3 inches long, leaf-like, expanded, and often larger than the blade itself, obversely cordate, or obovate ; oblong, at the base contracted in a single petiole ; flowers, 4–5-merous small white,* on very short glabrous pedicels ; ovary obovate, terminated by a very thick style. Berries obovate, or irregularly globose, the size of a citron, or larger,† very uneven and warty, almost juiceless, with a thick yellow skin ; not infrequent in tropical forests of the Martaban hills ; also in upper Tenasserim ; often cultivated in native gardens."

Dr. Trimen also thought that the *lima* of Ceylon and the C. hystrix of Kurz are the same thing. Possibly this *lima* got into Ceylon through the Dutch, having been brought from the Malay archipelago by their servants, as an insecticide, and by change of climate and soil its fruit may have varied. But more probably, judging from its name *lima*, it was a Portuguese introduction from the same direction.

In the Malay archipelago the *Limo ventricosus* of Rumphius occurred in Celebes ; in almost all the islands of Amboyna, as also in Banda. "Everywhere,

* In the Ceylon *lima*, I found them slightly tinged purple.

† A rather vague size. I have seen citrons from three to ten inches long.

however, it is not common but rare." In his time, it appears that this citrus had already undergone a certain degree of cultivation, as he describes the skin as having a scent "pleasanter than in any other Indian lemon, and better than that of the Spanish lemons, or equal to them." He says it is the skins of these lemons that are most used for scrubbing the head; and the juice, which is very acid, is mostly used for paints.

With regard to the *Limonellus*, or *Limo tenuis* of Rumphius (corresponding to the *kaghzi nimboo* of India), he says it is "*vulgatissimus et usitassimus.*" "It is found from Java to all the East Indian islands, not in the forests, but everywhere near habitations, planted and carefully cultivated." For it to have been so much used, and so much disseminated in the Malay archipelago, about 200 years ago, it probably must have been introduced, *if it did not originate in some of those islands*, some hundreds of years before the time of Rumphius. If, as I surmise, it descended from the *C. hystrix*, it probably had its birth either in the Malay peninsula, or in the islands. And as it was much used for all domestic purposes, kept well, and was taken on long sea voyages, nothing would have been easier than for it to be carried along the coast up to Bengal, and to both the Eastern and Western coasts of India, as well as to Ceylon, by Arab traders, and others. As its seeds germinate easily, and the seedling trees fruit in four or five years, its naturalization all over India would then have been a matter of time.

In the chapter on Derivations of native names of citrus, I have discussed the probable derivation of the the word *nimboo* or *limboo*, which probably also has a Malay origin. The true lime is evidently a variety

only found in cultivation, and its characters fixed by long association with man. Whether it originally came from the *C. medica*, or from the *C. hystrix*, the change has been equally great. The final solution of this interesting problem, however, viz., the origin of the true lime, must now be left to others, if its solution be possible.

Note.—In the Linnean Society's Journal—Botany—vol. xxii., will be found a paper on the "Probable wild source of the whole Group of Cultivated True Limes" (read on 4th February, 1886). That paper, however, contains the mistake, then undetected, to which I alluded on p. 83, viz., that in the *Explicatio* of Rumphius the figs. were transposed.

Pls. 225 to 233 give figures of this group.

CHAPTER XI.

CULTIVATION OF THE ORANGE AND LEMON IN INDIA.

In the Journal of the A.H.S. of India (Part IV. New Series, vol. 1, of 1869, p. 372), kindly lent me by Mr. Blechynden, secretary to that Society, I found a description of the orange groves of Shalla, in the Khasia hills, by C. Brownlow, Esq. He says: "Here, in one large connected piece, of about 1,000 acres, is the garden that supplies a great part of Eastern, as well as Western Bengal with oranges. One may walk for a good hour or two, always under the shade of orange trees, without reaching the limits of cultivation, and when, as in December and January, every tree is laden with ripe fruit, no sight can be more enjoyable. I have been through the Sorrento gardens, but this beats Sorrento, and the Neapolitan orange growers would find some difficulty in selecting out of their entire 'piano,' a piece at all approaching this." *

"The way the oranges are gathered in the Khasia hills is this. A man with a net-bag open at the mouth by a cane ring, and slung on the back by a strap passing over the right shoulder and chest, climbs a bamboo ladder, plucks the oranges and puts

* It should be kept in mind that the Shalla and Sorrento oranges have no connection, other than that both are *oranges*. Those of Shalla are of the *sùntara* type. Those of Sorrento are of the *Malta orange* type.

them into the bag. Before descending, he removes all the dead branches, moss, and parasites, within his reach; after descending, he empties the bag, and climbs to another part, and so on. A *dhaw* (or hatchet-knife) sticks in his belt, to chop off any dead or cankered branch, or to cut out a bunch of the *bandha* parasite (Loranthus species).* The orange trees receive no other handling than the above. They are never systematically pruned, or thinned, and are allowed to retain just what fruit they set, and yet the crop turns out wanting neither in size, flavour, nor abundance. Contrast with this the elaborate summer and winter pruning of the French gardens, and the systematic cultivation and manuring of the Genoese.†

"There is no regularity in the planting of the orange trees, but no vacancies are left. In 1869, no grafting or layering was ever practised, but all the Shalla plantations were raised *from seed.*

"In the Shalla groves there are trees of considerable age, that have lived out at least three generations of men. These old trees are great fruit bearers, and are valued accordingly.‡ Some yield 1,000 oranges. Whatever may be their age, they never grow to a greater girth than 3 ft. (about one foot diam.), or to a greater height than 20 ft. Should a tree of this age be blown down, they endeavour to right and prop it up. Trees frequently get sickly, and gradually perish, without any assignable cause, before reaching maturity,

* This parasite infests many trees, especially the *mango*, in Upper India. It should be cut out and burnt.

† In the chapter on the commercial products of the orange and lemon tree, will be seen the *reasons*, why in the South of Europe so much attention is devoted to these trees.

‡ Here is a hint for selection. Instead of selecting seed from *any* tree, select from those which are much valued.

as well as after; and, from the quantity of dead trunks stacked for firewood, the rate of mortality seemed high.*

"The windfalls are peeled, and given to pigs and dogs, and it is remarkable to see how dogs have become by habit to relish them.†

"The enemies that have to be contended with are crows, parrots, hornbills, and monkeys. Boys with pellet bows are employed to drive these robbers off.

"Besides the sweet orange (*kamla lemboo*), the shaddock (*sokowit*), the citron, sour oranges, limes and lemons are cultivated in groves, all scattered about promiscuously. The Khasias are very fond of the sour orange,‡ and eat it with salt.

"The orange tree thrives best on the left bank. There are trees on the right bank, but they don't thrive so well. The orange land forms a wedge, interposed between the Shalla river and one of its branches. It is inundated to a depth of 4 to 6 ft. several times in the course of the rains, the water, however, never stands on the land more than a few hours. Towards the interior, the height of the inundation may vary from 6 ft. to knee deep. The houses of the watchmen are raised on stout posts of 'jack,' or *toon* wood, driven in deep. The house proper is 15 ft. above the level of the ground. During a flood, the pigs, dogs, fowls, and goats take refuge on a lower platform, beneath the house proper.

"Limestone first appears a short way above the orange gardens, and first below Shallapoonjee."

The Shalla villagers depend entirely upon the pro-

* This may probably be from exhaustion, want of manure, and no care, or from injury to roots by underground insects, &c.

† In South America, and other places, cattle are fed on oranges and lemons.

‡ It is impossible to say what sour orange this may be. *Vide* Appendix, No. 43; also pls. 257 and 258.

ceeds of their permanent plantations. These hill tribes are conterminous with the Sylhet facing, and it is along this facing alone, and the valleys and slopes which descend into the plains, that permanent plantations of oranges, jack, betel palms, and pineapples are to be found, together with villages also of a permanent character, and yearly improving.

To make the oranges keep after gathering, the Khasias expose them on *machâns** in their houses, with the wind blowing through, and turn them over frequently.

Mr. Brownlow sent a sample of the soil from the orange groves of Shalla to Calcutta. It was analysed by Mr. David Waldie, F.C.S., and found to contain the following ingredients :—

Dried at 212° Fahr.

Alumina	6·09
Peroxide of iron	4·93
Lime	·19
Magnesia	·13
Alkalies (by difference) and loss	·80
Silica solut.	·15
Sol. in Hy. Chl. acid	12·29
Then—	
Alumina, chiefly with a little oxide of iron and a little lime	3·49
Dissolved by heating with Sulphuric acid, organic matters, and combd. water lost by burning	5·66
Silica and quartz	78·56
Parts	100·00

* Stages made of bamboo, or other material.

Mr. Waldie notes, "It will be observed that this is a very siliceous soil, proceeding from the decomposition of siliceous rocks alone. It contains no carbonate of lime, and is a very open and porous soil" (p. 393 of the above-named journal of the A.H.S. of India).

Liebig's analysis of the *ashes* of the orange-tree *wood* gives :—

45	Lime.	In 100 parts of the ashes *insoluble* in water.
1	Iron and manganese.	
6	Silica.	
7	Magnesia.	
1·9	Phosphoric acid.	

100 parts of the total ashes give—

Soluble in water	9·6
Insoluble in water	90·4
Parts	100·0

And 100 parts of the insoluble ingredients give 45 per cent. of lime, that is, nearly half the quantity of the ashes, insoluble in water, is lime.

But Mr. Waldie says that the Shalla soil sent him contained only 0·19 in 100 parts, or less than $\frac{1}{5}$ per cent.

The inference is that either Mr. Brownlow took his sample from some one particular spot, or did not reach the calcareous soil.

The orange wood requires, it appears, a considerable amount of lime to make healthy growth; in Shalla, oranges grow very well; therefore, the soil of Shalla should contain a considerable amount of lime. Moreover, it is hardly credible that in a district where limestone forms one of the exports, that no lime detritus is ever washed down with the floods, which are said to

be frequent in the rains, and often flood the orange groves of Shalla to the depth of 6 ft.

Mr. Brownlow's description of the orange groves of Shalla was written in 1869. Recently I asked Mr. G. Stevenson, Depy. Comr. of Sylhet, to kindly furnish me with some details, which would bring the subject up to date. Some part of the information he courteously gave me is placed under the head of the "Orange and Lemon Trade of India," Chapter 13.

In forwarding the following note (28th October, 1885), he said, it was made by the sub-divisional officer, in whose sub-division lie the best groves. He added, "At Shalla I have seen a kind of orange, small and round, something like a blood orange, but rather lighter in colour. It is not so sweet as our common orange (the *kamla lemboo*), but the people here call it 'Royal orange.'"*

The sub-divisional officer says, "My informations have all been compiled from the two large orange producing tracts in the northern boundary of this sub-division, I mean the Shalla and the Phorarpungi tracts (at the base of the Khasia hills). They are, in fact, the only tracts on this side which carry on an extensive business in oranges. I met with the greatest difficulty in compiling these statistics. The Khasias received my inquiries with suspicion, and tried to mislead me as much as possible. I have, however, used so many different tests, and have so carefully corrected all doubtful points by personal observation, that I may fairly claim for them approximate accuracy.

"*Soil.*—The soil must be sandy. This seems to be an essential condition. The trees thrive most where this sandy soil is mixed up with either red or black ferruginous earth. It is also necessary for success

* This may be the *usoh sim* or *raja orange*. *Vide* Appendix 43.

that the soil should be capable of retaining a good deal of moisture. The difference of production is great in dry and moist soils. In the latter if there be fifty oranges per tree, in the former there would be only five to ten. Generally speaking, a garden would do well in a soil made up of half sand and half earth, and most of the gardens on this side are under these conditions.

"*Situation of gardens.*—From their peculiar situation, the gardens here have natural advantages, which I doubt if gardens in California possess. There are several hill streams, some small, some comparatively broad, coming down from the Khasia hills into the Surma river; and the gardens extend for miles along both sides, spreading also to a considerable distance inland. They are, in fact, situated between a network of small hill streams, which overflow their banks during heavy downpours. This answers for irrigation. The rush of water is very strong, so long as the downpour lasts, but the flood subsides within a few hours. During these freshets, every part of the garden goes under water, not infrequently 5 or 6 ft. deep, or more. The gardens thus get thorough washings more than once during the rains. Being situated on river sides, their soil naturally retains some moisture, even in the dry season. Hence, perhaps, artificial irrigation becomes unnecessary. The Khasias never irrigate their orange gardens. They do not even water young trees. They entirely depend upon nature here. When questioned, they laughed at the idea of people making orange gardens by irrigation.

"*Raising Plants.*— Seeds are taken out of mature oranges in February and beginning of March. They are well dried in the sun for two or three days.* A

* There is a general notion that when orange and lemon seeds are dried too much they don't germinate well. Is this so?

nursery is prepared either on the ground or on a raised 'machàn.' The earth, to the depth of about nine inches, is finely powdered and sifted. The surface being smoothed, the dry seeds are spread over it and are then covered over with finely powdered and sifted earth to the thickness of an inch. The ground is then covered over with plantain and other leaves, during the heat of the day, the covering being removed in the evening and some water sprinkled over the surface. This process goes on till the seeds germinate, generally between 20 to 30 days. In the seed nursery the plants are allowed to remain till they are about four inches high. Then they are transplanted into a second nursery and placed eight or nine inches apart, either in May or June of the same year. The soil of the second nursery is lightly hoed before transplanting and then it is kept free of weeds and foreign trees. Here they are allowed to remain till, in the end of the 3rd or 4th year, they have grown to a height of four or five feet. They are then finally planted out in the gardens. In the second nursery no hoeing or watering is necessary, and all that the Khasias do is to clear any jungle trees with their *dhaw* twice, and sometimes three times, in the year. The garden is never hoed or harrowed before receiving the orange plants. It only once undergoes a thorough clearing of all jungle with the '*dhaw*,' and a hole dug for the plant. After planting, all that is done to the orange garden is to clear it of jungle growth twice or thrice a year. Neither hoeing, nor harrowing, nor irrigation, is required. The seasons selected for jungle clearing are at the beginning and end of the rains. The Khasias always put in the plants *obliquely*. The reason they give is that new and straight shoots are given off near the root, and the original oblique one withers away.

Then the leading root-shoot is left, which grows more vigorously and forms the future orange tree. In an orange garden, on an average, about 300 trees go to an acre.

"*Fruit Bearing.*—In good soil the trees will bear fruit about the sixth year from the date of germination, and about the third year after planting in the garden. In exceptional cases they have been known to bear fruit by the fifth year. In average soil, however, the age of fruiting is calculated about the eighth year. The first year of fruit bearing the number of oranges is from five to ten per tree ; the second year about 50 ; the third about 150 ; the fourth about 500 ; and the fifth year of bearing about 800 oranges per tree are given. After this they continue to yield about this average (800) per tree every year. In the eighth or ninth year of bearing, however, the yield reaches not infrequently 1,500 oranges per tree, and in rare cases even 2,000. My informant showed me *one* tree which last year had borne 2,250 oranges. This was, however, a very exceptional instance, and I could not discover another tree in any part of the garden which had been so fruitful.

"In good soil, an orange garden retains its fruit-bearing condition unimpaired for about 50 years, and in average soil between 30 and 40 years.

"*Rent, &c.*—The Khasias have no rent to pay for their lands, which appear to be the *ijmali* property of the *Pungi.* Each takes as much land as he can conveniently manage. Whole *Pungis* sometimes make joint orange gardens, which are the *ijmali* property of all. The Khasias neither know nor understand any measurements, and they have no idea whatever of the extent of their gardens."

Mr Brownlow stated that the Khasias sow the

orange seeds thickly, in January and February, in troughs or boxes. He has also seen them sown in a canoe, but preferably they are sown on raised *machàns* (there called *machàng*) to keep them out of the reach of pigs. Nets are also thrown over them to keep off rats and squirrels. The *machàn* is a raised platform, on supports, made of bamboo matting, well supported beneath by slabs of betel palm. On these about six inches of soil is laid. These nurseries can be located anywhere. They are well looked after till the seedlings get through their first few leaves. In the ensuing rains they are pricked out in a second nursery, in the ground, by shaking the earth from their roots, without injury. They are eventually planted out in gardens.

In the *Indian Agriculturist* of 10th October, 1885, an "Old Mallee" writes that he "realizes eight annas a score for Sylhet oranges, which he grows in Bengal; that his income from orange growing is Rs. 700 per acre, at 10 feet apart." This, he says is too close. The expenses of growing them he puts down at Rs. 100, so that he nets Rs. 600 per acre. He considers well-decayed night-soil, cowdung, and black tank-soil, with an admixture of slaked lime, or old mortar finely powdered, the best manure for orange trees. He buds on the *khàtta* stock. He grows principally the Sylhet *sùntara* variety, but has also the Delhi *sùntara*. The latter variety, he says, does not fruit so well in Bengal as the former. He says he has been an orange grower for thirteen years, and has found that after the trees have given a full crop for three successive years they begin to die off most unaccountably.*

* Probably from exhaustion. In the Azores, before dying, the trees produced enormous crops. Rumphius mentions the same thing.

So he plants out a fresh lot of young trees between the older ones as soon as the latter come into bearing. By this method his plantation is periodically renewed. He says the extra expense is trifling, and the gain is great.

It would appear that the *sùntara* race of orange trees do not live so long as the Malta orange race, or the Sévilles.

There appears, however, something decidedly wrong in the "Old Mallee's" orange garden. It is not impossible that after a certain age the roots of his orange trees get into bad soil, or that in Bengal his garden is imperfectly drained, or that it may be a mistake to *bud* the *sùntara*, instead of raising it from seed. Growing it on its own roots from seed or layers might prolong its existence. When an orange tree has come into full bearing, it would appear bad economy not to prolong its life as much as possible. Decayed night soil, cow-dung, and black tank-soil are all good in their way; but the orange tree should not want the mineral ingredients which have been shown to enter into the composition of the orange wood. Even when all the ingredients required are given without stint, a bad subsoil, and, in damp climates, bad drainage, and over-cropping, which is the vice of all Indian cultivators of fruit, may defeat all other efforts. A dog may nurse only a limited number of pups comfortably, but an orange tree, they think, can nurse an infinite number of oranges year after year without harm.

With regard to the cultivation of the *sùntara* orange about Delhi, the "Old Mallee" makes the following statement: "In the Goorgaon district, Delhi division, are to be seen miles of orange plantations, and nowhere have I seen this delicious fruit grown to greater perfection, although apparently little or no care

is devoted to its cultivation. In Goorgaon they sell oranges from four to six rupees per maund. I saw there old trees, but they were gnarled and seedy-looking, and the Mallees assured me that they were always replacing these old trees by young ones raised by budding."

The little observation which is here made, viz.: "apparently little or no care is devoted to its cultivation," may probably explain the reason why the orange growers of Goorgaon "are always replacing these old trees by young ones raised by budding." *

Where the natural condition of the soil, as the natives express it, *kabool kartà*, or "consents" to nourish vigorously a variety of orange tree, and make it productive, little manure may be necessary at first, but it should be always remembered that the right mineral ingredients of a soil are not always in that condition which enables the roots to *utilize them freely*, and, therefore, they are not inexhaustible.

Someone might here ask, how is it that in primeval forests, without any manuring and without any care, immense trees go on growing, so to speak, for ever? The answer is not difficult to find. 1st. The trees of a natural forest have been specially selected on account of their suitability to those surroundings. 2nd. Tons and tons of produce are not removed from the forest and taken elsewhere, in many cases to find their way under other forms to the bottom of the sea. 3rd. From the first year of life of a forest tree, it returns to the soil, in the shape of fallen leaves, all it takes, excepting what goes to form its wood. The bark, in many cases, is also shed, and when a tree decays and dies, its wood also is soon reduced to powder by

* Further on I have given my own experience of the orange gardens of Delhi.

myriads of fungi, and serves as nourishing mould for other trees. Then, such forests are always tenanted by animals, birds, &c., which probably drop in the forest more than they remove. There is, therefore, a natural system of conservation in a forest which the owner of an orange grove would be wise to imitate. All manner of rubbish and refuse might be utilised as manure—pigeon, fowl, and pig's dung being, perhaps, among the best.

With regard to the value of manures, the following occurs in the *Gardeners' Chronicle*, of April 25th, 1885, p. 535, on the "effect of manures on the growth and quality of fruit." In this article it is sufficiently proved that certain mineral ingredients in the manure and soil are essential to the production of good fruit. It is there shown that manured fruit trees produced better, sweeter, and finer fruit than the adjoining unmanured trees. It is also stated that many of the diseases of plants classed under the names of mildew, blight, &c., can be escaped by proper manuring, thus furnishing the mineral ingredients necessary to the healthy growth of the tree, and production of healthy fruit and seed.

In the Khasia hills the *kamlà* orange tree is simply stuck in the ground and then left to nature. The only help it gets from the cultivator is to free the soil roughly from competing jungle trees, and to cut off once a year any parasitic plants and dead wood. In the several annual floods, however, he may have a compensating element. The floods not only irrigate the orange gardens, but deposit a silt which may be perpetually renovating the surface soil, and it is presumed the fallen leaves remain there. Even under these favourable conditions, Mr. Brownlow says that orange trees there frequently sicken and

die without any assignable cause, before reaching maturity as well as after, and from the quantity of dead trunks stacked for firewood, the rate of mortality seemed high.

The orange planter should always keep before him what has been stated in Appendix, No. 32. "In the Azores, the finest orange gardens in the world, the trees up to 1836 were in perfect condition; no care, no attention, and no labour was given them, save that of picking, packing, and exporting the fruit. The trees were left without manure, without draining, and may be without pruning. The people sang, they danced, and amused themselves, while the trees pumped out of the soil its essence to feed the oranges. When ripe they *exported the most valuable part of their soil in the shape of oranges to London*, and then perhaps they sang and danced and enjoyed themselves more vigorously by the aid of the proceeds of the sales, without giving a thought to the need of compensating the soil for its annual loss. They woke up one day, however, to find disease spreading among their orange groves, and to see trees 200 and 300 years old, and producing each from 6,000 to 20,000 oranges, disappearing!"

G. W. Septimus Piesse, in his "Art of Perfumery," published in 1879, gives us some idea of the care and attention given to the orange tree in the South of Europe. He says:—"Before planting the orange (sweet Portugal or bitter Séville), a tree which attains great age, the soil upon which it is to live must be well prepared, otherwise the after life of the tree will not be of that thriving condition which we could desire. The soil should be trenched at least to the depth of four feet, and well manured. The care bestowed on the infant plant will be seen

50 years, nay even a century afterwards. A tree requires 15 years to reach maturity, but will produce both flowers and fruit in four or five years. When in full vigour each tree yields an average of 25 pounds weight of blossoms annually. Many plantations at Nice are more than 100 years old. At Fontainebleau there are now to be seen orange trees planted by an ancestor of mine 200 years ago."

It should be remembered that in the South of Europe, besides taking the excess of flowers for perfumery purposes, enough are left to produce an ordinary crop of fruit. A given tree can only support a given amount of fruit, but the flowers are far in excess of the amount of fruit which it will carry, and so this excess is gathered and sold fresh daily to perfumers.

The following, taken from the *Gardeners' Chronicle* of 20 June, 1885, p. 796, may help to impress the reader with the value of manures and good general tilling of the soil, especially when a large quantity of the soil, &c., in the shape of fruit, is annually removed.

"*Food of plants derived from the atmosphere and the soil.*"

"No plant can attain full development without a sufficiency of potash, phosphoric acid, and nitrogen. Besides these, lime, magnesia, sulphuric acid, chlorine, and perhaps silica, are sometimes, if not always, indispensable to produce perfect growth, though in some cases they are only required in fractional proportions.

"The largest constituent of plants is water, which forms nearly $\frac{3}{4}$ to $\frac{9}{10}$ of the weight of common garden plants. The next largest constituent is the organic matter, which is from seven to 25 per cent. And finally, the ash constituents which remain after the

plant is burnt, form from one to six per cent. of the plant in its natural condition.

"The roots not only suck up solutions in water, but also attack solid ingredients of the soil, and they do this by exuding an acid juice which the roots contain. This important function of roots is carried on in different degrees in different plants at the point of contact with the root. This action plays an important part in the supply of phosphoric acid, potash, lime, and nitrogen to the plant, the latter being taken up in the form of nitrates.

"The soil is made up of its 'natural strength,' that is, made up of disintegrated rocks, with the aid of air, moisture, warmth, and frost, and also by the agency of minute bacteria. This action goes on, whether the soil is cultivated or not; at the same time proper tillage aids the work wonderfully. Even without the latter, the stock accumulates as long as *less* than it contains is taken. It is in this way that fallow ground recuperates, and that virgin soils have acquired their richness. What the soil will thus do for itself slowly, the gardener may do for it more quickly by manuring.

"For this purpose we have at command—

"(1.) Stable and farm manure, and refuse of various sorts.

"(2.) Rubbish of all kinds, ashes, marl, lime, and other cheap materials.

"(3.) Commercial fertilizers.

"The first contain all plant food, but are slow in their action. They, however, improve the texture of the soil.

"The second contain less plant food, but they improve the texture of the soil also, and change the dormant constituents of the soil more readily, and turn them into assimilable forms.

"The third (like potash-salts, phosphates, bones, guano, ammonium-salts, and nitrate of soda) contain plant food in very concentrated, and readily available conditions. Their principal ingredients are phosphoric acid, potash, lime, and nitrogen.

"These mineral ingredients, and the quality of the soil, in addition to climate, are, however, only one part of the whole business. The other parts are the rare qualities of a successful agriculturist, or horticulturist, by whichever name he may be called, although, in reality, there is no difference between the two. These are 'shrewd observation, watchful care, and unceasing industry,' qualities which are much sharpened if one's living depends on them."

The following is a memorandum on the mode of cultivating and propagating the Nagpur orange, drawn up by the Superintendent of the Government Garden, and kindly favoured me by Mr. J. B. Fuller, Commissioner of Settlement and Agriculture, Central Provinces:—

"The orange delights in a rich, black, loamy soil, properly drained. It is propagated by budding, and sometimes by inarching. Plants raised by budding are much hardier, though slower to fruit, than grafted ones, and hence this mode of propagation is more generally employed. The operation of budding is also simpler than that of inarching.

"The sweet lime is generally used as stock to bud or graft the orange on. Citron* stock is also used for this purpose. Seeds of the ripe fruit of the sweet lime or citron are sown about the middle of January, care being taken to sow the seeds as fresh as possible. Most of the seeds fail to germinate, if left even for a

* I fancy by *citron* here is meant the *khatta* orange, which by most English is called citron.

few days to dry, after being taken out. In the beginning of the rains, the young seedlings are transplanted into another nursery, giving the plants one foot of space every way. By September of the next year, the plants make sufficient growth to allow of their being budded on. The budding is continued till about December. When the budded plants have sufficiently grown, they are transplanted into their permanent quarters in lines, 15 ft. apart, and with the same distance between the lines. The trees begin to bear about the fifth year, but it is not till the tenth year that they are considered to be in full bearing. They bear two crops in the year, viz., the 'Ambiabàhar,' so-called from its setting at nearly the same time the *mango* crops set, at the end of February and in March. The fruit of this crop ripens in December and January. The other is called 'Miragbàhar,' because it sets with the beginning of the rains, in June and July. The fruit of this ripens in February, and onwards till May.* The trees are generally allowed to bear only *one* of these crops. In March watering is gradually lessened, and is completely stopped in May. Then, as soon as the soil is dry, a few inches of earth round the trees is removed, to expose the roots. This exposing of the roots continues from a week to a month, according to the richness of the soil. Manure is then heavily applied, and the roots covered up with fresh earth. Water is then freely given, and in a few days the tree is full of blossoms and new leaves."

It is presumed that this treatment is given to those trees which are set aside for the "Miragbàhar" crop, which in the North-West Provinces is called *Dumrêz* crop.

* This is the *Dumrêz* of other places.

The following is the mode of cultivating and propagating the Delhi *sintra,* there called also *rungtra.* This information has been kindly favoured me by Mr. George Smyth, Deputy Commissioner of Delhi. The memorandum was drawn up by the Tehsildar of Delhi.

"The *rungtra* orange can be raised from seed, but the fruit of seedling *rungtra* is very sour,* and the tree knarled. In consequence of this notion, in Delhi orange trees are not raised from seed, but by budding the *rungtra* on the young *khatta* stock, when the latter are three years old from sowing time. Three years after budding, the *rungtra* will bear fruit, and later on will be in full bearing. The fruit the trees bear is large and sweet. It is not raised by layers and cuttings, because in Delhi they have a notion that these do not bear fruit. Provided the *rungtra* orange tree is manured and watered regularly, it will continue to fruit annually for a hundred years.†

"The budding is usually done in January, on *khatta* stock, raised from seed, as has been stated. The plants that have done well are then transplanted into permanent orchards, in carefully prepared and manured holes, and watered regularly. Weeds should be kept down, and the soil stirred frequently. If due care be given to the trees, each orange tree will bear from twenty *seers* to two *maunds* of oranges annually."‡

Mr. Ridley, the Superintendent of the Horticultural Garden of Lucknow, has for several years been conducting some interesting experiments on orange cultivation. He has very kindly given me the result

* It should be noted that natives believe that if *any sweet* orange seed is sown, the result is a *sour* orange tree ; this is not true.

† From my own observations, given in another place, this is very doubtful.

‡ A *seer* is 2 lbs. ; a *maund* is 80 lbs.

of his experience and experiments, in the following paper on the cultivation of the orange, lime, and other varieties of citrus.

"In the cultivation of the orange, as with other fruit trees, the most important consideration after climate, is that of soil. It has of course been amply proved that the orange will grow and even flourish in soils of various quality; but the best results, both immediate and continued, can only be realized in a soil possessing the necessary ingredients and qualities required for the proper nourishment and development of the tree, and its produce. In India, owing to long continued cultivation, and other causes, such a soil is, I should think, rarely met with, and the intending orange or lemon grower has consequently to consider the deficiencies of the ground he intends to devote to this culture, and to take steps to supply the same, as far as possible. A rich, rather heavy loam, of an open and free texture, is well suited for growing oranges, lemons, &c., and in such a soil the trees would probably give very satisfactory results, without the addition of manure or other fertilizing stimulants, for a number of years.

"In starting a plantation, I would strongly recommend that the ground be trenched to a depth of two and a half or three feet. If the soil is either poor or of too heavy and tenacious a character, the opportunity should be taken of improving it, by the addition of manure and new soil as the trenching proceeds.

"In the case of a light sandy soil having to be dealt with, a liberal addition of strong clayey soil, or turf, from a river bank, or *jheel*, * should be given; also leaves, bazar-sweepings, indigo refuse, horse and cow dung, with a small addition of powdered

* Small lake, or big tank.

lime. Excepting the last, the other additions should be freely used. If the trenching is done during the rains, all these ingredients may be applied fresh, as they will soon decay at that season. Care should be taken to thoroughly incorporate these fertilizers with the whole soil, as it is turned over, and not to bury them all at the bottom of the trench, and so place them for years out of the reach of the roots of the young trees which they are intended to nourish.

"For stiff clay soil, brick kiln refuse,—the rougher, the better,—coal ashes, wood ashes, indigo refuse, leaves, stable litter, bazar sweepings, and lime should be used, either the whole, or in part, as may be available, the object being to counteract the natural adhesiveness of the soil, and make it as friable as possible. A free open soil is, I believe, a matter of great importance for the successful growth of the whole of the orange and lemon tribe, and what is of still equal importance is good subsoil drainage. A wet, waterlogged soil, I would pronounce as utterly unsuited for growing oranges and limes.

"The soil of the Azores, where the famous St. Michael's oranges are grown, is described 'as generally a friable loam mixed with volcanic matter; for the most part this soil is said to be of considerable depth, but many orange gardens are formed in places where there is not more than fifteen or eighteen inches of soil above the shattered mass of rocks and rubble.' This very clearly points to the desirability of a free, open soil, and also of a good subsoil drainage.

"Some experiments bearing on these two important points were begun in the Horticultural Garden of Lucknow in 1879. The object at first was to ascertain if the common '*kaghzi*' lime would grow in old demolition mortar, but subsequently the effect

of drainage, trenching, and various fertilizers was tried in addition.

"For convenience of reference, the series of experiments undertaken are here called A, B, C, and D.

"*A* consisted of a ridge three feet high, ten feet wide at the base, sloping to six feet wide at the top; the whole composed of demolition mortar, and a fair amount of broken brick mixed up with it.

"*B*, a similar ridge as to dimensions, but composed of two parts natural soil (a poor yellow loam), one part alluvial clay, one part decayed sweepings, and one part demolition mortar as used in *A*.

"*C*. A trench four feet deep and ten feet wide was dug. In its bottom large lumps of fused bricks (*kunjur**) were laid to a depth of one and a-half feet. To keep the soil from washing in and filling the interstices a thick layer of palm leaves and other leaves was laid over the *kunjur*. The trench was then filled to the surface level with the following compost: Three parts natural soil, one part alluvial clay, two parts decayed sweepings, all being well mixed together.

"*D*. A line ten feet wide was trenched two feet deep, and the soil to that depth enriched, as the trenching proceeded, with night soil, decayed sweepings, and alluvial clay.

"When all the soil of these experimental plots had consolidated, two plants of each of the following were put down on each plot, viz.: Sylhet, Nagpore,† and Malta oranges, and Lucknow and Agra *kaghzi* limes.

"With reference to growth in the case of the *kaghzi* limes, the trees are mostly equal in development and vigour on all plots, a slight advantage being perceptible

* I believe in England these are called "clinkers," and are used for rock-work.

† Sylhet and Nagpore oranges are *sùntaras*.

in those on *C*. Their foliage is of a deeper green, and more healthy-looking, but the yield of fruit on all plots appears to be the same, both in quantity and size.

"Of the oranges, the Maltas have made least growth on all the plots, but the trees are more healthy and better developed on *C* than on the other plots. They have also yielded the best fruit. In point of general success, the second place, in the case of the oranges, is held by *D* plot.

"On the whole the result very clearly demonstrates the beneficial effect of subsoil drainage, and also of trenching, both for oranges and limes, and the fact that both having made good growth and fruited well when planted on pure demolition mortar, affords, I think, strong evidence that the tribe they represent appreciates an open free medium for their roots, and also a good amount of lime in their soil.

"Next, if not of equal importance for the successful growth of the orange tribe, is shelter. In the Azores, the groves are said to be surrounded by high walls and lines of trees, while guava and other fruit trees are grown among the orange trees to afford shelter and protection from the strong sea breezes. In Spain, too, it appears, the orange plantations are chiefly placed in sheltered valleys.

"This question of shelter, for not only orange but all fruit trees generally, is not, I fear, sufficiently attended to in Northern India. The strong, hot and dry west winds which prevail during May and June, act very injuriously on vegetation in general. They are, however, particularly hurtful to trees carrying a crop of young fruit, which all the citrus tribe do at that season. In Upper India, shelter is chiefly wanted on the west side. In the case of small gardens, a single or double row of guavas might be planted on that side. The

kumruk tree has dense foliage, and it would answer for either small or large gardens ; while for the latter, jacks, seedling mangos, or a thick line of *Inga Dulcis* might be tried, the shelter lines of trees being repeated at intervals in large plantations. For the same reason I would recommend moderately close planting of the orange and lime trees themselves.

"In good soil the *keonla* and Malta orange trees should be planted fifteen or sixteen feet apart each way, the distance being reduced two or three feet in poor soils. The Sylhet does not spread much, and ten to twelve feet will be sufficient space for it. The same may be given to *kaghzi* limes, and *chakòtra* pummelos; and for *mastabi** pummelo, Malta lemon, sweet lime, *khatta* orange, Nagpur and Séville oranges, twelve to fourteen feet would be enough.

"Planting may be done from the commencement of the rains to the end of January, but the best time for putting in the trees is during the rainy season. If the ground to be planted has been trenched and manured, it will not be necessary to put any manure into the holes with the trees when planted, but if a little well-decayed cow or horse dung can be spared, it would prove advantageous by promoting root action and aiding the trees in establishing themselves in the new sites.

"A circular bed (*thàla*) should be made round each tree for the purpose of irrigation during the dry season. This may be small at first, but care should be taken to enlarge its diameter as the tree develops. The branches and roots spread in about equal proportion ; it therefore follows that watering a small bed immediately around the stems must leave the greater portion of the roots without water, and that probably at a

* This is the same as *mahtàbi*, and a further corruption of *batàvi*.

time when the leaves and branches are making their greatest call for moisture.

"From the time of planting onwards the whole of the ground should be dug over at least once a year, the object being to keep a loose open surface. If a second digging can be given all over the surface of the plantation it would prove highly beneficial.

"Weeds and grass should be rigorously kept down, and the surface of the beds around the trees should be stirred as frequently as possible.

"From the time the trees commence bearing, an annual surface dressing of manure will help them greatly. When the soil has been well prepared, however, or is naturally rich, it will not perhaps be necessary to give any manure for three or four years after the trees begin to fruit, but it is most undesirable to defer manurial aid till the trees show evident signs of suffering from want of proper sustenance.

"In England camel dung is considered the best manure for orange trees, but as it is not generally available in quantity, either cow, horse, sheep dung, or night-soil, singly or combined, may be used. A good sprinkling of wood ashes, lime, or broken bones being added. The best time for applying this surface dressing is during the rains, as the fertilizing ingredients contained in the manure are immediately carried down into the soil and to the roots by the rain. The trees being then in a growing state are able to appropriate at once the nourishment given.

"In applying the manure one or two inches of the surface soil of the bed should be loosened and drawn aside. The manure should then be spread over the surface, forked into the soil, and the whole immediately

covered over with the same soil, which has been drawn aside. If a fork is not available a '*kodâr*' will answer for digging in the manure.

"In the case of trees which have been planted in poor and untrenched soil, and which may not be thriving satisfactorily, substantial benefit may be afforded by digging a trench around the trees, 2 or 2½ feet deep, and of the same width. This trench should then be filled with a liberal addition of new soil, alluvial clay, and such manure as may be available, care being taken to mix the whole well with the earth taken out before the trench is re-filled.

"The distance which a trench of this kind should be from the stems of the trees depends in a great measure on the size of the trees, but three or four feet may be regarded as a minimum distance. The point to be kept in view is to bring the fertilizing matter as near as possible to the main body of the roots without destroying many of them in doing so. When the trees appear to have exhausted this new material, a second trench, with similar materials, may be dug outside the first, if the space, between the Citrus trees admit of it."

If the reader will look over the various modes of cultivating and propagating the orange tree, he will see that there are various ways of raising young plants of almost any sort of Citrus.

In Sylhet, and presumably in Bootwal also, no other method of raising orange plants, except from seed, is thought of. The Sylhet orange is admittedly a very good orange, and the one grown in Bootwal is the sweetest of the *sùntara* type. The Sylhet orange of Lucknow was originally raised from seeds of oranges obtained from Calcutta by Mr. Hodges. It maintains its upright habit like its parent in Sylhet. It is now

largely propagated by budding, and is one of the best varieties they have in Lucknow.

Both in Nagpore and in Gujranwàla they bud on the stock of the sweet lemon (*mitha nimboo*, or *sherbetee*). The Nagpore orange is the best flavoured of the *sùntara* type, and the Gujranwàla blood orange the best of the Malta type. It is perfect. There is, therefore, reason to believe that the stock on which the bud or graft is inserted may have some influence on it, and so modify to some extent the flavour of its fruit. It is a point well worthy of attention in Government experimental gardens. If confirmed by further experiments, the sweet lemon stock might become *the* stock for all sweet oranges, while the *khatta* or sour orange might be used solely for all sour oranges, lemons, and limes. Probably even the Pummelo might be much sweetened and improved by budding on the sweet lemon.

The reason the *khatta* stock is so universally used is that the seeds germinate well and produce strong, hardy plants, which make rapid growth. The *malis* in Lucknow state that the *khatta* seed germinates better if taken from the unripe fruit about August. It certainly germinates then, but I fancy the reason is that August is warm, and the winter, when the *khatta* is ripe, is cold. Of a large number of Citrus seeds of all kinds, from various parts of India, sown in the winter, very few germinated till February and March, when they came up by hundreds.

I do not see why layering the Citrus is not practised. It would give strong, healthy trees on their own roots. If layered in the beginning of the rains, rooted layers would be obtained before the end of the rains, while at least two years are required to raise stock, bud it, and make plants fit for planting out;

and to raise plants from seed of good kinds for planting out, about the same time would be required, and they take longer to fruit. (See Appendix, No. 42.)

I have layered the Malta orange, the Séville orange, the *kaghzi* lime, and the Malta lemon. The latter, however, is the one which roots with the greatest rapidity. I have raised hundreds by layering it in pots. (See Appendix, No. 42.) I have seen branches of the Malta lemon that simply *touched* the ground, root at the point of contact and fix themselves to the ground; and I have seen the *kaghzi nimboo* flower the *second* year after the layers were planted out, although there is no advantage in trees either flowering or fruiting when they are so young. All the vigor, however, and all the early fruiting will much depend on the amount and quality of nutriment given to the plants at starting, irrespective of the way they have been raised. In the Etawah Jail Garden, in 1882, I found some seedling *kaghzi* limes. They told me they were about a year old. I planted them out in big holes, 13 feet apart, filled with demolition lime pounded fine, ashes, and manure, and watered them regularly. I gave them only 13 feet between the plants, thinking they would not make rapid progress. Now, four years after planting, they are 13 feet high and their branches have met, so that the plot has become a thicket. Almost all are bearing fruit. Every year, in the hot weather, the soil round them gets several dressings of dry leaves, so as to economize water; these leaves in the rains, together with the fallen leaves of the trees themselves, form a superficial layer of nourishing leaf-mould.

With regard to cuttings, I found that those of the Malta lemon will strike readily in the rains, in the shade, and I had several of them thus raised planted

out. I have not tried to raise other kinds by cuttings. But Mr. C. Nickels, of Jaunpore, has frequently propagated the Citrus by means of cuttings. The following he has very kindly sent me as the result of his experience in this mode of propagating.

"Oranges and lemons, especially the latter, are very easily raised from cuttings. The best time is during the rains and the early part of the cold weather. I strike my cuttings in a mixture of pure sand and charcoal, under a glass. It is essential that the sand should be pure. This is obtained by boiling the sand in water in a clean vessel, and then washing it in several waters, when it can be dried and kept for use. The charcoal should be reduced to powder. When required, a mixture of 11 parts of prepared sand to one part of charcoal is made, and a sufficient quantity put into small 4-inch pots. Then take your cuttings from a healthy tree. Cut off several branches and bring them to the potting shed. I select shoots about six or eight inches long, with a heel of ripe wood and bark. These I pull off and plant all round the pot, but never in the centre. About a dozen cuttings go comfortably into a 4-inch pot. The pots should then be watered and each buried up to the rim in a larger pot of common sand, and covered over with a bell glass. In the absence of regular bell glasses common wall shades (*fanoos*) can be used, stopping the opening at the top. A glass frame or glass box will do just as well. The leaves of the cuttings must on no account be shortened, as the more leaves are on the slips the sooner they will strike.

"Every night the pots or boxes should be placed out in the open air, and taken in again in the morning. Water should be given as they require it, and twice a day they should get fresh air for a few seconds by

taking off the bell glass or opening the glazed box or frame.

"When struck, which will be known by their beginning to grow, they should be gradually hardened. This is done by opening the glass, or removing the bell, for a short time towards the early morning, and keeping it open for half an hour. The second day it might be kept open for an hour, and so on till the plants are thoroughly hardened. A week or ten days is sufficient for the hardening process. When the cuttings can stand the open air all day long without injury, they are ready for potting.

"The rooted cuttings should then be turned out of the pots, and the sand and charcoal washed away. Each rooted cutting should then be carefully potted separately in 4-inch pots, taking care that the new and tender roots are not broken. The best soil for them at this stage is a mixture of two parts leaf mould, one part roasted turf, and one part sand, well mixed together. (I should feel inclined to add a good sprinkling of pounded demolition mortar or lime.—E.B.) After they have been carefully potted and watered, a piece of potsherd should be applied to the drainage hole at the bottom to prevent its being stopped by the outside earth, the pots should be buried up to the rims in the open ground. For a few days, however, they should be protected from the sun by means of a mat covering, removing the latter at night. Here they can remain for six weeks or so, when they require a shift into larger pots. When these pots are filled with roots, the young trees are ready for the final planting out.

"For this operation I dig holes in the ground 6 ft. wide, and 4 ft. deep. The soil dug out I remove, and replace it with silt from the bottoms of tanks,

adding leaf mould and sand. The proportion I use is two parts silt, one part sand, and one part leaf mould. (It should not be forgotten that lime enters largely into the composition of the citrus wood, and that if the soil does not contain it as *kunkur*, or in some other form, it should, I think, be added.—E.B.) When the holes are filled with the above mixture they should be watered, and the soil allowed to settle down. After planting, you should water liberally. The after treatment consists in mulching (top dressing) with leaf mould and cow manure.

"The *kaghzi nimboo* is rather difficult to strike from cuttings. With lemons, 80 to 90 per cent. will strike, and with oranges, I consider 60 per cent. a good average.

"The advantage of layering is that you get a rooted plant with greater certainty, but the process is no quicker than propagating from cuttings. Of course you can obtain a larger plant by layering than you can from cuttings in a given time."

The Sùntara Orange Gardens of Delhi.

In the month of October, 1886, I visited the Delhi fruit gardens in search of information about the *sùntara* orange. In Delhi this orange is called either *sintra*, *sungtara*, or *rungtra*. I expected to find there first-rate gardens of this fine orange, but was much disappointed. Everywhere I saw very great slovenliness of cultivation. Forest trees are allowed to become mixed up with the orange bushes. Nowhere did I find a neatly-cultivated orchard of this *sùntara* variety.

The Delhi cultivators say that it likes the shade of other trees, and does best under the shade of the

bair (Zizyphus sp.). It is well-known that this delicate orange and its varieties get scorched on the sunny side by the direct sun-rays. The scorched fruit is almost worthless, while that shaded by the tree and its leaves is perfect.

However, in Delhi the fact is that this orange is jumbled up under all sorts of forest trees, which either were there before the orchards were planted, or germinated afterwards, and were allowed to remain there.

The long road between Delhi and Kurnaol, to a great extent, is lined on both sides by extensive fruit gardens, and wherever the *sùntara* orange tree is planted, forest or other trees must suck up both manure and moisture, so that this unfortunate and delicate orange bush is everywhere either starved or otherwise damaged.

All cultivators say that this orange tree likes a *kunkur* (or stony) soil, and there appears plenty of stone in and around Delhi, which in many places crops above the surface. Mr. Lionel Jacob, Executive Engineer, Western Jumna Canal, informs me that the Delhi stone is a *quartzite*.

Orange growers in Delhi are unanimous in stating that *well water* is better for the *sùntara* orange than *canal water*. They say that the fruit is sweeter in the former case than in the latter; and that the tree perishes earlier when irrigated by canal water than by well water. The latter, however, is an expensive mode of irrigation. In a large garden, three or four wells are required to be worked constantly, more or less, for two-thirds of the year. This entails several sets of men, and several pairs of bullocks, while canal irrigation is much cheaper. Mr. Lionel Jacob informs me that in Delhi "the canal water-rate for gardens is

Rs. 3, 2 annas per *bigah*, or Rs. 5 per acre. In addition to the above, there is the owner's rate for irrigated lands, which is half the water rate, or for gardens would be Rs. 2, 8 annas per acre. The owner's rate is paid by the owner of the land, and the water-rate by the cultivator. Of course, they may, or may not, be one and the same person. I should mention that the above rates are for gardens irrigated by *flow;* if irrigated by *lift*, the water-rate and owner's rate is two-thirds of those noted. The gardens about Delhi are, however, almost entirely irrigated by *flow*. The depth of water from the soil varies a good deal. A large number of the Delhi wells are filled with canal water, to make them sweeter drinking. In these, and in the wells situated in irrigated lands, the water is nearer the surface than in wells at a distance from the canal. Speaking roughly, the water would be in the wells of the neighbourhood about 25 ft. from the surface of the ground. The Delhi soil is, generally speaking, *rausli*, or loam."

It is probable, as cultivators say, that canal water is not so good for the *sùntara* orange tree as well water, but I take it, not *because* it is canal water, but because it is cheap, and, therefore, *too much* of it is given.

I was shown a plot in one garden, which was said to have been planted some twelve or thirteen years ago with *sùntara* orange trees, and irrigated by canal water. All the trees, they said, perished in about ten years. The plot was then replanted with *sherbetee nimboo* (sweet lemon). Cultivators say the latter does not mind canal water.

In another garden, newly formed, I saw orange trees which had been planted some four or five years before. They were all in a most wretched condition. I saw water lying on the surface, and was told that canal

water had been given three or four days before. The ground appeared as if it had been just irrigated. It was no wonder the poor orange trees looked wretched and dying. The whole ground was water-logged, and hardly fit for even plantains ; it might have suited rice.

In the Saharunpur Botanic Garden, which is irrigated by canal water, I noticed the same unhealthy condition in the citrus trees. It appeared to me the soil got too much water. Mr. Gollam observed that all the orange trees everywhere about Saharunpur were in a similar condition. I do not know whether all these also were irrigated by canal water.

The *sùntara* orange tree does not appear to mind excess of water occasionally, provided the soil be well drained. In the Khasia hills, the *sùntara* orange gardens are several times during the south-west monsoon flooded, it is said *to the height of six feet*, but the drainage, after the water retires, is so good, that the trees do not suffer by these floods.

In one garden near Delhi, owned by one Mohamed Shah, near the bridge called *Anda moghùl ka pul*, I saw the following interesting mode of cultivating the *sùntara* orange tree in combination with other plants. The garden was irrigated by well water, and, of course, the usual slovenliness and indifference about mixing up trees, &c., was there also in full force.

In this garden the orange trees were mostly shaded by *bair* trees. It must not be supposed, however, that there was any system of planting. The *bair* trees appeared to have germinated spontaneously, and at a certain age been grafted in the usual way with the *large* cultivated *Zizyphus*. Natives say that the orange tree does best under this tree, because its time of pruning, shooting, and fruiting suit the times of the orange tree.

Moreover, the *suntara* orange tree is more of a *bush* than a large tree. In this particular garden, a third plant was combined with the *bair* and orange trees, viz.: the *Jasminum sambac*, or *bêla*. I shall, therefore, enter into some details about the management of this particular garden, however rude its method may be.

When the *bair* trees have been grafted and grown to a certain size, *suntara* orange trees are planted among them, and between the latter again, the low bushes of the *bêla* jessamine are planted. The strongly-scented flowers of the latter are much appreciated by all natives, and, therefore, find a ready sale, while the large, egg-shaped *bair* fruit are devoured in great quantities by natives during their season.

The grafted *bair* trees shed their leaves towards the end of winter. At the beginning of spring they are severely pruned back, and after a month or so they begin to shoot out again. Without this severe pruning, natives say the *bair* tree does not fruit satisfactorily. Pruning hardly describes their method sufficiently—*amputation* would be the better term. At that time, the orange trees, freed from the *bair* tree shade, get a good deal of direct sunlight. This enables them to ripen their younger wood for the production of next season's flower twigs. During the winter the soil is turned and kept dry for about two months. When the orange trees flower and the fruit sets, manure is given, water saucers round the trees, and water channels are made, and the ground irrigated three or four times a month. In winter, while the fruit is still on the trees, they are watered about twice a month. The orange trees and the jessamine bushes flower about the same time, the latter continuing longer in flower. The owner of this ground said that canal water is injurious

to the orange tree because too much is given, and then the heat of the sun kills the young, newly-formed rootlets. Probably he meant that they are partially *stewed*. He said leaving the fruit for a long time on the tree, although it fetches a better price, weakens the tree, and prevents it from fruiting well next season. Sometimes it is allowed to remain on the tree for a month after Christmas. The weakening effect might, I think, be easily modified by leaving only a small proportion of the fruit on *each* tree.

As the young oranges swell, the vigorous new shoots of the *bair* trees lengthen and spread, and eventually make an umbrella-shaped head to the tree. The *bair* foliage is small and not very dense, so that a great deal of diffused light reaches the orange trees. In due course, the long *bair* branches become covered with tiny flowers, and then with fruit. The *bêla* flowers are gathered daily as they blow, and the *bair* fruit as soon as it becomes of full size and ripe. I believe Furukabad and Shahjahanpur are noted for the best varieties of grafted *Zizyphus*. Some of the best fruit is as large as small hen's eggs.

I have no doubt that if this mixed cultivation of *bair*, orange trees, and *bêla* were carried out systematically by planting the *bair* and orange trees *regularly*, in alternate rows, giving each a sufficient space, with the low jessamine bushes between the other trees, good profit might be made, and with advantage to the orange crop, provided regular manuring and watering were given. After the oranges had swollen to a certain size, the umbrella shaped and tall *bair* trees, if properly trained would afford just the amount of shade needed by this variety of orange, to prevent scorching by the direct rays of the sun, in Summer; and at the time of pruning the

bair trees, the orange bushes wonld get a sufficiency of direct sunlight at the period they most wanted it, that is at the period of shedding their leaves, and ripening their wood for flowering. I think this system if intelligently carried out, for cultivating the *sùntara* orange in the plains of India, has a great deal to recommend it. The aforesaid Mohamed Shah, of *Anda moghùl ka pul*, claims to have been the first to have struck out this new method of combining the *Bêla* with the orange and *bair* trees.

There is little to add to Mr. Ridley's memorandum on the cultivation of the citrus. As he has, however, proved that the whole tribe, planted in *nothing but demolition mortar*, thrive well, there is in my opinion no need to fear using it liberally. I never hesitate to use it in basketfuls, and I see no reason to fear its liberal use. I think that demolition mortar, besides acting as manure, tends to open the soil, especially where it is of a tenacious nature. Of course, where there is plenty of *kunkur* in the soil, that will furnish enough lime for the wants of the citrus trees. The other manures which I found very useful are wood or charcoal ashes, manure of all sorts, and rotted leaves.

There is a source of manure which few think of; I mean brick-kiln ashes. As a mineral manure, I should say few equal it. If we consider what fuels natives use to burn their bricks with, we shall soon learn to look upon brick-kiln ashes with favour. They use wood, *kànda* (dried cow dung), night-soil, and town refuse of all sorts. The latter, especially in Mahomedan cities, contains a large proportion of bones. All these calcined, and mixed up with burnt and powdered clay make one of the best possible mineral composts. Then the addition of leaf mould, decayed animal droppings, lime, and ordinary garden soil

would make a perfect bed for all the citrus tribe; all ingredients, however, should be thoroughly mixed up together. Of course, unless the general soil is naturally rich, or is annually renewed by inundations, as in the case of the Shalla orange groves of the Khasia hills, the trees should be annually manured, when they attain their fruiting age.

Iron appears to be an important ingredient in the orange soil. It exists in that of the orange groves of Shalla. The red soil of Ceylon is said to be impregnated with iron, and probably the similar red soil of South India, also contains it. I do not know what the composition is of the black soil of the Central Provinces, and other parts; but probably it contains iron, as the Nagpore oranges do so well in it. I have a notion that iron gives flavor and juiciness to the orange, but to decide this, very careful and prolonged experiments would be required. However, I may perhaps have discovered a simple mode of detecting the presence of iron in the soil, especially when this is not naturally black. I have noticed that in the light coloured soil under *babool* trees (*Acacia arabica*), after rain, the surface becomes blackened. Tannic acid, with persalts of iron, and gallic acid with proto-salts of iron give a black colour. The *babool* bark and leaves contain tannin, and the rain falling over a *babool* tree would naturally wash some tannin on to the ground beneath, tannic acid being soluble in water, in the proportion of ten parts in eight of water. So that it would, I think be possible by the simple means of strewing *babool* leaves on the ground and watering them, or by irrigating the surface with an infusion of *babool* bark, to discover the presence of iron in the soil. Anyhow, the probability is that the citrus tree requires it in small quantity, and in

case the soil were totally devoid of it, it could be easily added in the shape of the cheap *cassis*, or sulphate of iron of the Bazars.

In North Western India, and in all places where hot winds prevail, shelter from hot winds is a very important provision for many varieties, especially those of the *sùntara* type, so much so, that, in my opinion, the mandarin orange, the most delicate of all, cannot be grown in places subject to the hot winds, as it is all but killed by them every year.

In places where the soil is suited to orange culture, and where there are facilities for irrigation, it would pay to have high mud walls, tiled on top, all round the orchard. They are not very expensive to make, and with an annual plastering of cow-dung would last long. If the soil be of tenacious character, the mud for the wall might be dug from the ditch outside, which would make the wall still higher for thieves. This would admit of the orchard being under lock and key, which is of great advantage when the fruit begins to ripen; because then a caretaker by day and night with a couple of country dogs to help him would completely secure the crop from thieves, however late it might be left on the trees.

If, however, the orchard be on a large scale, and no facilities at hand for erecting mud walls, then other means of shelter might be available. Mr. Ridley recommends for this purpose guavas, *kumruk*, jacks, seedling mangoes, &c. But I think that perhaps a more useful wind-break, at the same time that it acts as a hedge, is to be found in the common *kaghzi nimboo* tree.* If raised from seed, or from layers, it

* Curiously enough, in the "Botanical Miscellany," vol. iii., p. 29, Dr. Macfadyen recommends the lime tree also for a fence in Jamaica.

makes a high bush, with the lower branches close to the ground. And if the trees are planted, even at 10 ft. apart, in a good-sized trench filled with good soil, and the ingredients mentioned before, it is wonderful how soon an impenetrable and high lime-tree hedge can be made. In an extensive orchard, lines of lime trees, planted in the same way, and running north and south, might be very advantageous as hot wind-breaks. The little *kaghizs* are great favourites, and are always saleable. The reason for preferring this lime tree for hedges and wind-breaks is this; although I think it originally an *imported* citrus, it has, for ages, been raised from *seed* everywhere, so that it has had ample time to naturalize itself, and, in all these generations, adapt itself to the surroundings of a hot-wind climate. It has, therefore, become hardy, and the hot winds do it little or no harm. During the process of making a lime-tree hedge, some temporary fence might be made.

I think it would be advisable, in Government gardens, to raise plants of all useful varieties of citrus from *seed*. This practice might result in hardier varieties being bred, and more suited, by both natural and artificial selection, to their local surroundings. It should not, however, be the principal aim of an experimental and acclimatizing garden to *pay its way*. It will pay *indirectly* by introducing useful and suitable fruit trees among the population.

A few words may be now useful, regarding the operation of budding, for the advantage of beginners. This is done in the same way as for budding roses, by inserting one or more buds of the desired variety under the bark of either the *khàtta*, Séville, or sweet lemon. The best time for this operation is in January and February, when the returning warmth produces

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activity in the juices of the trees. Then the bark can easily be separated for the purpose of budding. The best thickness of the stock is that of a thick pencil up to half an inch in diameter. This thickness, under favourable conditions, will be attained in about two years. The best knife for this purpose is what is called a *budding-knife*, procurable from any hardware merchant. Its ivory handle has a fine edge, by which the bark can be lifted, without cutting or injuring it. Any handy *mistry* might, however, imitate these budding-knives, and the handle can be made of any hard and polished wood. The great advantage of budding is that, if stock is at hand, cuttings suited to budding might be obtained by post from a distance, and each bud carefully detached and inserted on the stock; so that in one season hundreds of any desired variety might be raised. Most native gardeners can bud plants, and, if not, they can be easily taught to do it. The operation is done as follows: Stock of the right size is selected, and the lower thin branches are shaved off with a clean cut close to the stem. Then a clean piece of stem of the tree to be budded is selected, with good plump buds, at the angle of the leaves, and free from spines. Half an inch of each *leaf-stalk* is to be left attached to the stem. It forms a convenient handle to lift the bud-shield by (*chasmà*). The most convenient way of detaching the shield is this: Make a sufficiently long *cross cut through the bark* a quarter of an inch *above* the bud, and a similar cut at the same distance *below* the bud. Unite the two on the left side by a longitudinal cut at the same distance from the bud, and, finally, make a similar cut on the right side; detach and lift the shield by the edge of the knife, and tilt it into a cup containing a little clean water. In this way detach all the buds you

require at the time, each with its shield of bark, and drop them into clean water before you commence their insertion. If your stock is well grown, and has long stems, two buds may be inserted on one stem, one above the other, on the *north*, or *shady side* of the stem. If the stems are short, one bud will do. For the thicker stems, select cuttings which will give shields of about the same thickness; for thinner stems, smaller shields are better. Make a longitudinal cut *through the bark* in the middle of the stem to be budded on about an inch long, and three or four inches from the ground. Slightly bend the part cut so as to make a sort of concavity towards you. This bending will enable you to lift the bark of the stock much more easily. By means of the handle edge of the budding-knife lift up the bark on both sides sufficiently so as to enable you to slip in a shield. Take the shield by its little handle and insert it, bud upwards, carefully under the bark of the stock, so as to place the bud and handle in the middle of the slit; adjust the shield neatly to the wood beneath, and straighten the stem. By this the two bark edges will close tightly over the shield. See that the latter is *flat against the wood.* Finally, bandage the stem tightly above and below the bud.

The best bandage is that of dry plantain stem, soaked in water, and cut into thin strips a quarter of an inch or so wide, and cleaned of all pith. If sufficiently soaked, it makes a pliable, strong, and efficient bandage. The bandage should be applied from below, with one end secured under a loop, and after two or three turns below, and as many above the bud, the end of the bandage should be drawn through a loop and tightened, so as to secure it firmly. The object of the bandage is not only to keep the bark, shield, and wood

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in close proximity, till they all unite, but to prevent air getting into the slit, and drying the bark and shield.* The whole length of the slit, therefore, should be evenly bandaged. The shorter the slit, consistent with ease in inserting the shield, the better the operation. A practised hand can bud hundreds of plants in a day, and the more practised it becomes, the more neatly and safely will this easy though delicate operation be performed. It is a good plan to irrigate the ground one or two days before budding. The budding operation had better be done in the evening or early morning, and a full watering should be given to the budded plants immediately after. These appear trifling precautions, but upon them will often depend the success or failure of budding. If the young trees are in the shade, such as that of *agast* trees, planted especially, so much the better.

A week or so after budding, if successful, the handle of the shield will drop off on the slightest touch. This means that the shield has adhered, and is fed by the stock. If the handle is dry, and will not easily drop off, the chances are the shield is dead, and a few days later this same stock can be rebudded higher up or lower down.

As the weather grows warmer, the foreign bud will begin to grow, and then the main shoot or shoots of the stock should have their tops pinched off so as to check their growth and help that of the new bud. Should any of the stock buds appear on the stem, they should be removed with the same object. Watering should now be carefully attended to, and slight surface leafage will economise water. As the bud grows, the stock stem may be gradually reduced. I think it a

* For this reason, perhaps, the middle of January is a better time for Upper India than later, provided the bark can be easily detached.

mistake to remove all the stem and leaves of the stock at once. The leaves are needed to keep up the circulation of the sap and feed the bud. When it has grown to the length of about five or six inches, the stock stem can then be completely removed to within an inch above the bud. This operation will have to be done carefully, as the foreign shoot is still fragile and easily broken off. As the shoot grows, thin stakes should be driven into the soil, and the shoot secured by some soft tying material, to prevent its being broken off by the wind, until it becomes strong.

The successfully-budded trees will be fit to plant out in their permanent places, in the rains, and any stock shoots which may appear below the bud should be removed. Those trees in which the bud failed to take should be shifted into a new nursery in the rains, and a new shoot encouraged near the root, so that it may be trained for budding on next February, the old stem being cut off close above the new shoot.

When the buds begin to start and grow, all they require, beyond what has been said, is to watch for caterpillars and destroy them when found.

Although budding has its advantages, it requires time at first to raise the necessary plants for budding on. The plants require at least two years from the seed, in a rich soil, with all necessary care, to fit them for receiving the buds. Some say they require three years for this purpose. In my opinion, where facilities are available for keeping the *khàtta* fruit on the trees, it is better to take the seeds of these *ripe* fruits and sow them rather thickly in pans containing rich soil, and placed in the shade of trees, and sheltered from hot winds. They will germinate freely in March, and if caterpillars do not destroy them, and if they get regular watering, they will be fit to prick out in a well

prepared nursery a foot or more apart by the ensuing rains. The most forward then can be budded in the following February.

Native nurserymen who raise citrus plants for sale always keep *khàtta* stock on hand. They manage their nurseries very well, and are experts in budding and shifting young citrus trees. Anyone starting orange or lemon plantations on a large scale would do well to employ a good native nurseryman from one of the large cities, to raise stock, and bud it for him with any variety he may prefer. This should be done in the vicinity of the plantation. The long, cane-like branches of the previous rains generally furnish the best buds for inserting on the stock. Having once secured plants of any desirable variety, it is not difficult to propagate them by layers, which can generally be easily taken from the lower branches.

If the plants are in a nursery, they should be taken up carefully with a large ball of earth. Natives usually lift plants with too small a ball of earth, and, therefore, too much of their roots is unnecessarily chopped off. The evening is the best time for planting. Regular watering will be required throughout the hot dry weather. No watering will be needed during the wet season, provided there be an average rainfall, and during the winter only an occasional watering will be required. Of course these rules hold principally for all those parts of India subject to the hot winds. In other parts these rules can be modified according to circumstances.

In heavy rains, surface drainage should be attended to, as too much water lying at the roots will cause some of the fruit to drop off. In hot, dry weather, as I have repeatedly stated, surface leafage—to be renewed when the leaves crumple up and decay—will econo-

mize water. Care should be taken, however, not to *mass* dead leaves round a tree, as, when wetted in large masses, they *heat* and might injure the roots. In addition to its own fallen leaves, this surface leafage, if properly attended to, adds annually to the leaf mould and nourishes the surface roots.

With regard to pruning, a little observation will show that the flowers of the Citrus are produced from the small twigs of the previous year. These, therefore, should not be pruned off. On the contrary, when the tree has attained a certain age they should be encouraged in preference to the strong cane-like branches, which rarely bear fruit, till they have given off small side twigs. Therefore, when a tree has attained its full bearing age these cane-like branches might be removed—except when wanted to fill up a vacant space—in order that the fruit-bearing twigs on the surface of the tree may be encouraged and multiplied. The object of pruning, besides removing any dead and weak branches, is either to give shape to a tree or to reduce the unproductive wood, with the view of increasing the fertility of the fruit tree. In this way, the annual nourishment given to it, after it has attained its full size, will go mainly to the production of fruit. This art is managed to a nicety by the French orange growers in the South of Europe. There is, perhaps, no fruit tree known which responds so readily to any attention and care it may receive.

In a large plantation it would, perhaps, be advisable to set apart a portion of the trees for a *Dumrêz* or rain-crop alone. At first this might be done experimentally, and then, if it turns out profitable, this alternate cropping might be carried on systematically. In Nagpur it is said each tree is made to bear only one crop, either the spring or the rain crop. The *Dum-*

rêz crop of oranges in the N. W. Provinces has usually a dry pulp. I think this is because in that climate the same tree cannot nourish satisfactorily two crops. But if the fruit of the spring crop were all picked off some trees, so that in the rains, they might give a larger *Dumrêz* crop — which would be the *main* crop of those particular trees—a valuable lot of fruit, ripening in the hot weather, might be the result. Some experiments, I think, are needed in this direction to ascertain whether this system would pay.

There are two modes of training orange and lemon trees suited to this country, viz., either on one stem, with a bushy head, or on many stems, making a large bush from the ground upwards. The latter is the result of allowing the tree to grow as it chooses. The former is brought about by selecting a strong upright branch, when the tree is young, and removing all the side weak shoots below a certain height. This requires some care to do neatly. In Sylhet they plant their seedling orange trees in a slanting position instead of upright. Close to the root are then thrown up strong shoots, one of which is trained as a standard, while the original tree eventually withers away. Something of this sort might be tried with budded plants. The original stock which is budded low down, might be planted in a slanting position, with the base of the bud slightly under the soil, so that the latter may be trained upright. This might have the additional advantage of enabling the shoot to give off roots of its own, if it be of a variety which would easily do so.

Finally, never allow the *bhoojwa*, or gramparcher, to come near your orchard to sweep up the leaves for heating his oven. I maintain that one of the best manures for a tree is its own decayed leaves, and if you prevent their being removed they will, by

decaying, add to the surface soil the ingredients which the tree most requires. If, in addition, you give a careful surface leafage from any other trees every hot weather, you will in some measure imitate the process by which nature conserves its forests. This, however, will not be all that is required, as you will, of course, remove every year the fruit, which has to be provided against by means of manurial ingredients. If you attend to this *annually*, and stir up the surface soil regularly and frequently, there is no reason why, in good soil, your orchard should not stand for many generations, if you take the precaution to shelter it from the destructive hot winds where those prevail.

Before I quit this subject, I may as well recommend to intending planters two trees which may be useful for hedges. One is the *Carissa carandas*,—the *carawnda* of natives. It is a thorny, stiff-leaved bush, which in time becomes an impenetrable fence; moreover it produces an olive shaped berry, which is useful for tarts, and also for *chutny*. The other is the *Capparis sepiaria*,—*hisàree* or *hains* of natives. It is a wild small-leaved plant, with umbels of minute white flowers, and covered with small and large hooked thorns. Once you get entangled in it, every effort to disengage yourself from it will hook you on to fresh thorns. With a little observation, patience and trouble you might so fence in your orchard, as to make your fence equal to a solid wall, as far as thieves and cattle are concerned. Where possible, however, a high wall round your orchard has great advantages. It sucks *nothing* out of your soil. While your young trees are growing, you can take low crops from the ground between the trees.

I have found that the *agast* tree (*Sesbania grandiflora; akhatti* of Ceylon) is very useful for giving

light shade for nurseries. The seed of this small tree should be sown in lines, north and south, about a yard apart, at the commencement of the rains. The lines should have at least fifteen feet between. In one year, this tree, in good soil, will grow twenty feet high. As the trees grow, they can be thinned out to about twelve feet or so apart. This small and quick growing tree does not live a long time, but it can be easily renewed; moreover, it would be advisable to change the site of the nursery every five or six years. Besides quick growth, the *agast* has the great advantage of affording just the amount of shade needed for an orange nursery. The leaves are pinnate and not too dense. In South India and Ceylon, natives eat both the leaves, flowers, and young pods of the *agast*, cooked in their various dishes. I have often given its leaflets, mixed with other native plants, to prisoners, as a vegetable.

CHAPTER XII.

THE USES AND COMMERCIAL PRODUCTS OF THE CITRUS.

Everybody is acquainted with the ordinary domestic uses of the orange, lemon, and lime. The charming combination of sweet and sub-acid in a good orange is known to most people. The acid, however, should only be sufficient. The riper and sweeter the orange is, the nicer is the proportion of sweet and sub-acid. The small *suntola* orange of *Bútwal*, perhaps, is the sweetest of that type of orange. In Malta there is an acidless variety of the Malta orange, which is quite free from acid from beginning to end. It occupies the same position among oranges, as the sweet lemon, or *sherbetee* occupies among lemons, and the *madh-kakree* among citrons. The sweet lemon, though acidless, is a great favourite among natives, and they give a better price for it than they generally do for oranges. Varieties of sour-sweet oranges which give a large *Dumrêz* crop, are worthy of selection and propagation, on account of this very useful and profitable late crop. It ripens in the hot weather, when a juicy, sour-sweet orange becomes a luxury indeed. All those varieties of lemons and limes which give a heavy *Dumrêz* crop are also very useful and profitable, as such late lemons and limes would be invaluable in the hot weather. The *sadàphal*, a tasteless, and therefore useless citrus, flowers and fruits all the year

round. The Malta lemon often nearly approaches this character of perpetually flowering and fruiting. If these two could be crossed, a variety of juicy acid *sadàphal* might result, which would be extremely desirable.

In the hot weather, when the skin is acting profusely some people call for a *peg*. The moment this is imbibed, a *profuser* skin action occurs. This to a wise person would be enough to prove that although a *peg** is a valuable drink in case of exhaustion, it is *no remedy* for thirst in the hot weather. Even water alone, whether iced or uniced, is no remedy for thirst in the hot weather; no sooner do you drink a tumbler of water, than it all comes out through the skin, doing some good no doubt, but leaving your thirst as it was, a few minutes before. Let the juice, however, of either half a lemon, or a whole lime be squeezed in a tumbler of water, and it will be seen what a difference it makes in quenching thirst. I do not know how the lemon juice acts, whether by constricting the vessels which feed the sweat-glands, or by other ways; the fact, however, remains, that lemon, lime, and sub-acid orange juice are good quenchers of thirst. Just see then, how valuable fresh lemons and limes would be in the hot weather, to everybody, but more especially to European soldiers, among whom there are now-a-days numerous teetotalers. The sick in hospital, of all denominations, would be grateful for a cool drink of lemonade, or orangeade. The latter is rarely used; but even in winter, a hot orangeade, to a sick person, is very grateful. Few would, therefore, deny that fresh lemons, limes, and oranges in the hot weather, would be, not only very desirable, but would fetch a good price.

* Brandy and soda-water.

The most useful sour citrus for domestic purposes are, perhaps, the limes, when only a small squeeze of juice is wanted. When, however, a larger quantity of juice is needed, the Malta or Sicilian lemon is preferable; moreover, its juice is of a purer acid. I have been told that a Malta lemon does not give so much juice as a *kaghzi-nimboo.* In August I compared the quantity of juice of a small Malta lemon with that of the largest lime. Each gave a little less than half a wine-glass of juice; a large Malta lemon gave a full wine-glass of juice. The rind of the Malta lemon, moreover, is the best for flavouring sweet dishes. A ring of the outer *fresh* rind, stirred in with custard while on the fire, and taken out before serving, is enough to flavour a bowl-full. Then the Kumaon lemon or *gulgul,* is very useful, when a still larger amount of juice is wanted at one time.

If the cultivation of lemons and limes in India should at any time become so extensive as to make the fresh fruit of little value, I need hardly say that citric acid can be manufactured from their juice, both for pharmaceutical purposes and for aerated waters, of which the consumption in India must be enormous. At present, so-called aerated lemonades do not deserve that name. They are, in most cases, if not in all, really *tartarades,* or, perhaps, *sulphurades.* Tartaric acid, being much cheaper than citric acid, is largely used for making these so-called lemonades. Sulphuric acid, largely diluted, is often, I think, also used for the same purpose. I have no means of ascertaining how much citric and tartaric acid are imported for this purpose, but there can be little doubt that if citric acid could be manufactured cheaply in India, the genuine lemon and lime acid would be largely used for lemonades. It might be manufactured also from all sour

oranges, and any sour citrus with sufficient juice in it.

As to the uses of the citrus in perfumery, the perfumer had better speak for himself.

G. W. Septimus Piesse, in his book on the "Art of Perfumery," published in 1879, fourth edition, says:—

"During the season, there is at Nice a public market for orange blossoms. The bitter orange flowers (Séville) fetch three francs per kilogramme; those of the sweet orange, two francs. The market season for orange flowers at Nice lasts for more than a month, and during that time there are sold from fifteen to eighteen tons of flowers daily (!!!), and a ton of flowers will yield more than a kilogramme of otto, say forty ounces, worth 20*l.* sterling, and the residuary water (orange flower water) highly saturated with odour, is worth another 10*l.* note. Two distinct odours are procurable from the orange blossom, varying according to the methods adopted for procuring them. This difference of perfume from the same flower is a great advantage to the perfumery factor, and it is a curious fact, worthy of inquiry by the chemical philosopher. This duality of fragrance is not peculiar to the orange flower, but applies to many others, especially the rose —probably to all others.

"When orange flowers are macerated in a fatty matter, by what is called 'enfleurage,' eight kilogrammes are required to enflower one kilogramme of grease, divided over thirty-two infusions. This pomatum is then digested in rectified spirits, which takes up the essential oil, and forms extract of orange flowers. This scent is so fine that it cannot be recognized from that of the flower. From it 'Sweet Pea,' 'Magnolia,' and other scents are made up. If orange flowers are distilled with water, the Otto, or 'Oil of Néroli,' is

produced. This appears originally to have been dedicated to the memory of the Emperor Nero. He is stated to have had perfumed showers come down from the roof of his dining hall. He was evidently a great patron of perfumers. The finest otto is considered that which is extracted from the flowers of Citrus aurantium (Portugal or sweet orange). It is called 'Néroli Petàle,' or 'Néroli Douce,' sweet Néroli. The next quality is that from the flowers of the Citrus Bigaradia, or Séville orange. It is called 'Néroli Bigaràde,' or bitter Néroli.

"Another otto is distilled from the leaves and young unripe fruit of different varieties of citrus. It is called 'Petit Grain,' from the little oil specks in the leaves.

"The 'Nérolis' are largely used for 'Hungary Water' and 'Eau de Cologne,' and 'Petit Grain' for scenting soap.* Of the latter there are various kinds, according to the kind of leaf from which it is distilled."

(NOTE.—In Lucknow I once distilled "Petit Grain" from the leaves of the common *keonla* orange, and also some "Néroli" from the pummelo flower.)

All kinds of citrus leaves and flowers will yield, more or less, an otto by distillation.

Orange flower water can be used for the skin, the hands, and the eyes as a lotion. Its use for confectionery and for mixing with nauseous medicines is well known. It is also a good carminative.

The orange and lemon peels are rasped by a little machine called "Ecuelle"; or by a larger but similar machine. The latter is a sort of barrel or drum with spikes inside. In this larger machine 100 or more lemons are rasped at one time. The rasped rind is then pressed in hair bags, and the oil is afterwards

* There are now soap manufactories in India, and the distillation of orange and lemon leaves might prove advantageous.

allowed to stand and deposit impurities. It should be kept cool and in the dark, as the mucilage in it is said to cause decomposition and to spoil the essential oil. The best way to get rid of this mucilage is to shake the oil well with warm water, and then allow it to stand, and when clear decant it close to the water. The *expressed* oil of the lemon is the finest, and has an intense odour of lemons. This oil is called "Citron Zeste," while that *distilled* from the rind is not of the finest quality, but probably *keeps* better, and is called "Essence of Lemon."

England imports 85,000 to 90,000 pounds weight annually of the otto of lemon and "Citron Zeste." It comes principally from Messina, where there are hundreds of acres of lemon groves. Indeed, the extraction of the ottos of lemon, orange, and bergamot constitutes the chief industry of Sicily, particularly in the vicinity of Palermo. Nevertheless, what England gets from the South of Europe does not meet the demand.

The acid pulp of the lemon, after rasping off the rind, is pressed for citric acid.

The otto of the Citrus peel has many uses in perfumery, and is the leading ingredient in "Lisbon water" and "Eau de Portugal."

Mr. Piesse further says that "No tree is so profitable to the flower farmer as the orange, and emigrants to any of our warm colonies should make a note of this, and fix on their memory that the leaves of the orange tree yield an otto worth (in 1879) three shillings an ounce; the flower, an otto, worth ten shillings an ounce. That the flower, by 'enfleurage,' yields a fat worth eight shillings a pound, and the rind, an otto, worth twelve to sixteen shillings per pound. Moreover, if the fruit cannot be sold by the score in the

market, cut up and mixed with bran it makes a capital food for cattle."

The object Mr. Piesse had in writing the book on the "Art of Perfumery" was to induce the British colonies to take up the manufacture of ottos of various kinds. He then hoped that the extensive "Orangery" near Sydney, belonging to Richard Hill, Esq., J.P., might soon send its products from "our antipodean colony."

With regard to the lime, Mr. Piesse says: "It grows most prolifically on Monserrat, one of the Leeward Carribbee islands, and is now almost indigenous there. A Monserrat Company has been formed, under the management of Mr. J. Sturge. It annually produces no less than 1,000 pounds of the true otto of Citron, all by the Ecuelle process, and it is so pure that it is worth '*twice* its present price in the market,' but the products of Sicily compete with it to its disadvantage. Mr. Sturge says his citron* orchards consist of 500 acres; and that each acre contains about 200 trees. It takes seven years from the seed for them to come into full bearing. They flower, more or less, when they get rain, and the fruit ripens in about four months after the flower appears. They bear fruit all the year round,† but the chief harvest is from September to January."

Any further information regarding ottos and the preparation of scents can be obtained from this interesting work on the "Art of Perfumery." I have only extracted from it what concerns the Citrus family.

It should not be forgotten that in addition to foreign

* Probably *lime* is meant. Vide pl. 228, fig. *a*.

† For this reason, the *kaghzi nimboo* is called "*bàra mâsi*" by natives of India.

trade, Orientals are intensely fond of scents. Moreover, when Africa is opened out it will be probably found that the savages of Africa will appreciate scents, and will largely patronize perfumers. Most natives of India, however, prefer "ottos" pure and simple, rather than "bouquet" scents.

It may not be, perhaps, generally known that the so-called "aerated lemonade," if well made, is flavoured with "lemon oil"—the otto of the lemon rind, imported into India from Sicily.

In my experience I found that the plains of India are not very favourable for obtaining a large quantity of "otto" from any plant. The hot, dry atmosphere appears to dissipate a good deal of the essential oil of flowers and seeds, such as coriander, &c. Therefore, the orange flowers would have to be collected before sunrise in the morning, otherwise a cooler climate would be preferable for extracting ottos profitably—such as the Himalayan hills, wherever the Citrus can be grown without being destroyed by frost in winter. Wherever tea could be grown probably the orange, lemon, and lime tree could also be grown. It is said, for instance, that in Kumaon many kinds of Citrus grow to perfection; also in Buxa, Assam, and the Khasia hills.

Besides the extraction of essential oils from the Citrus rind, the latter can be made into "candied peel" for purposes of confectionery. A combination of citric acid, flavoured with lemon oil, I believe, enters into the composition of lemon-drops. In Appendix, No. 45 and No. 50, I have given a receipt for making candied citron and lemon peels, taken from the "American Grocer," and from an Italian cookery book. It is not an article likely to be made for export, but it may be serviceable for domestic purposes, and the internal trade of

India. I have always found that the imported candied peel has an unpleasant *turpentiny* flavour. The essential oil of the rind loses its charming aroma by keeping any length of time, however well bottled, while that freshly made is very fine. Moreover, imported peels are always very hard. As the Malta lemon is likely soon to be largely cultivated in India, these receipts may be of some use. Citron is already largely cultivated.

The Séville orange, I found, is grown in most parts of India and Ceylon. There is, perhaps, none better for making marmalade, and this preserve will improve by keeping. In the same Appendix, No. 49, I have given a receipt for making marmalade, taken from Francatelli's "Cook's Guide." The Séville or bitter orange has a very aromatic and bitter rind, and a sour pulp.

One of the best citrus preserves I have tried is the "lemon jelly," a receipt for which is also given in Appendix, No. 51. I think it was originally taken from the *Queen*, and kindly given to me by a friend. The best jelly is that made from the fresh Malta lemon, but any acid citrus fruit taken fresh from the tree can be preserved in the same way, such as the Séville orange, the lime, the *amilbêd*. The proportion of acid pulp to rind can always be regulated according to individual tastes by lessening the one and increasing the other, and if the fruit used is not sufficiently acid, more juice can be added from some other kind. One thing must be strictly attended to, however. The sugar used for this jelly must be of the *white crystalline* kind, such as that of Cossipore; otherwise the slightest amount of treacle in the sugar will make a *jam*, and prevent the jelly *setting*.

Finally, the citron peel is preserved in syrup in

Rampur, Rohilcund, and in Lucknow, under the name of *turunj ka muràbba.* Some kinds of citron peel that are not too bitter, can also be candied. A friend in India made some candied citron from the peel of the *madhkakree* of Almora, according to the receipts given in the Appendix. It succeeded admirably, and all who tasted it pronounced it *delicious.* It cannot be imagined how different the fresh, soft, and aromatic candied peels áre from the stale hard peels imported at a high price from Europe. Tons of marmalades and jams are annually imported from Europe, while all could be made in India of a nicer and fresher flavour.

We now come to a very important use to which the citrus family can be put. My belief is that in India the worst plague we have to contend against is intermittent fever, with its consequent disorganization of the blood, disturbed secretions, enlarged spleen, &c.

In 1885, in the Etawah Jail Garden, I had about three hundred Malta lemon trees in full bearing. At that time I read in the medical journals * that Dr. Maglieri of Italy had found that the peasants used a decoction of lemon to recover from the cachexia left by intermittent fever. He tried the experiment himself, and published the results. Then Dr. Lauchlin Aiken of Rome made other experiments with this decoction in cases of fever, and found it very valuable. As I had a large quantity of the same lemon on the trees, I undertook an extensive series of experiments to ascertain the real value of this remedy. I shall not here trouble the reader with the details of my experiments. They have been reported to Government, and published in the medical journals, and in "Braithwaite's Retrospect of the Medical Sciences." The conclusions

* *British Medical Journal,* of October 4th, 1884, p. 653, and "Braithwaite's Retrospect," ending June, 1885.

I came to from the series of experiments I made were the following :—(*a*) For simple intermittent fever, without any other complications, the decoction of lemon and of the *khatta* orange is almost as good a febrifuge as quinine, and acts with rapidity, even in tertian and quartan fever. (*b*) In cases of weakness and loss of appetite after fever the effect is even more quickly developed. It shows itself after the second dose, improving the appetite and digestion, and diffusing vigour through the nervous and muscular systems. I tried three kinds of sour citrus in such cases, and they appeared equally good. (*c*) In cases of recently enlarged spleen, even when of three or four months' standing, these decoctions (excepting the fluoride of ammonium, which is equally good) are the best splenifuges I am acquainted with. (*d*) When the spleen is very large and of years' standing, it takes a prolonged treatment to reduce and soften it. In such cases, probably neither the decoction of citrus nor any other remedy known will make the spleen entirely disappear, that is, reduce it to its normal size. To test the value of these decoctions in very large and old spleens, such as we often see in natives of India, it would require that the patient should voluntarily submit to the treatment for several months.

I believe all the sour citrus would be valuable in the above diseases ; but I had not the opportunity of trying them all. The most numerous trials were with the decoction of lemon ; then came a less numerous series with the decoction of *khatta* orange. I made some experiments also with the Séville orange and the ordinary lime. They were all valuable, but the most pleasant to take is, I think, the decoction of lemon.

It would appear, therefore, that in the genus citrus we have a remedial agent of much potency for inter-

mittent fevers and their consequences.* If chemists could be induced to take up the subject, and endeavour to extract the medicinal principle in some cheap form, a new departure in febrifuges and splenifuges might be brought about. The raw material can be grown everywhere, and during the season of 1885-6, it was stated that the fruit was allowed to rot on the trees in Sicily, because it did not pay the growers to pack and ship it to other countries, prices having been considerably lowered by competition from various parts of the world. If, therefore, the active principle could be cheaply extracted, not only the superabundant fruit of the world would be utilised, but a more extended market found for this important fruit. In Appendix, No. 48, will be found the receipt for making this decoction, according to the method used by the Italian peasants.

It would be interesting to find out whether the active principle exists ready-made in the fruit, or is brought out by the action of the boiling citric acid on the essential oil and bitter principle of the rind, and whether it exists only in some citrus, or in all the fruits of the genus, and whether it also exists in the leaves, bark, and wood of these trees. In Appendix, No. 46, *c* and *d*, are given the native modes of administering the lemon or lime for spleen, and in No. 52 similar uses are made of a kind of orange.

In the "Penny Cyclopædia" the following occurs: "In the West Indies, lemon juice, with common salt, is used in dysentery, remittent fever, dry belly-ache (colic), putrid sore throat, &c. Dr. Wright also recommends it in diabetes, and lientery."

"According to Sir G. Blane, the solution of citric acid is not so efficacious in preventing and curing sea-scurvy, as the recent lemon-juice."

* *Vide* Appendix, No. 52, and pl. 40, fig. *d*.

"Externally, slices of lemon form useful applications to scorbutic and other sores, and also at the commencement of hospital gangrene."

The Sèville orange, besides making the best marmalade, is used for making tincture of orange peel, which is mixed with nauseous medicines, to disguise their revolting taste. From its skin, orange candied peel is made. It is also used for flavouring the Curaçoa liqueur.

Natives of India make a very nice pickle out of the whole pulp of the lemon. Before they were acquainted with the Malta lemon, they made it from the pulp of the true lime (*kaghzi nimboo*); but those who have tried the lemon say that it makes a much finer flavoured pickle, and would not again use the lime if they could obtain the lemon. This lemon-pickle is not only nice, but will keep, with care, for a whole year. In Appendix, No. 46, are given receipts for making lemon-pickles of all sorts.

There appears to be yet another use, and a very important one, for sweet oranges. Latterly experiments have been made to ascertain the value of the juice of sweet oranges for making wine, and I believe this beverage is already manufactured in considerable quantities from sweet orange juice. Considering that in many parts of the world the phylloxera has ruined the vineyards, and that in consequence "chemical wines," of all sorts, have been abundantly poured on the markets, the news of a genuine wine, made from genuine oranges, will be acceptable to every one; at all events to all those who are not teetotalers. With reference to this new industry, the following occurs in the *Gardeners' Chronicle* of 13th February, 1886, p. 209. Under the head of "Wine from oranges," and quoting from the *Queenslander* it says: "In

response to our request for practical information, a vine grower, and wine maker, who has within the last few years visited many of the European continental vineyards, called upon us. He informs us, and wishes the fact to be made widely known, that a most excellent wine can be made from the juice of the orange, and that since the troubles caused by the phylloxera, a large proportion of the "sherry" of commerce, is "orange wine." The article adds, that in Florida, wine is being made from oranges.

Sugar forms a considerable part of the sweet orange juice. In addition, some varieties contain also varying proportions of mucilage and citric acid. There is no reason why wine of some sort should not be made from orange juice. There are very few parts of the world, where the cold is not too great, in which some variety of sweet orange could not be grown. Cultivation, and other methods would increase the amount of sugar. Who can say that the *Bootwal* sweet orange would not make a good palatable wine?

Upon the whole, many of the citrus fruit, especially the sour ones, are so useful and important in many ways, that villagers should be everywhere encouraged to grow them in their back yards, and anywhere, out of the reach of goats and cattle, near the villages. The daily drainage of water from their wells, bathing, and washing of pots and pans, if led by a channel to the lemon trees, would suffice as a daily watering in summer, so that once sown or planted, no further care would be necessary. The *kaghzi nimboo*, the Malta lemon, or *bukhâr ki nimboo* (as it is now sometimes called) and the *khatta* orange, are all so easily grown from seed and layers, that these useful remedies ought to be readily brought to the door of every villager in India, to be utilized on his first getting

intermittent fever.* If the properties and general usefulness of limes, lemons, &c., were taught in schools, it would not take much persuasion to induce every zemindar in a village to have a small garden, near a well, where some lemon or lime trees could be grown. The school is the best channel for introducing useful ideas among the people of India. The rising generation will then be almost sure to make them household sayings.

* It should be noted that natives believe that for the *first three days* of intermittent fever, *nothing should be done!* This is *Hakîm-nonsense.* The sooner intermittent fever is dealt with, the sooner it will be cured, and the *less* consequences will occur.

CHAPTER XIII.

THE ORANGE AND LEMON TRADE OF INDIA.

UNDER this heading will be of course included, not only the trade in oranges and lemons, but also in limes, citrons, and pummelos.

It would appear that on the North Eastern border of India, there are two or three places at which *sùntara* oranges are grown to some extent for exportation to other places. Nagpore and its surrounding country, in the Central Provinces, is another centre of considerable trade in oranges. Delhi is another. There does not appear to be any more centres of orange cultivation, except for local consumption, and for export to the immediate surroundings of the place, where they may be grown. Of course each station has its few orchards of oranges, but these are a mere nothing, and their produce is either locally consumed, or finds its way to the railway stations in the vicinity; so that a small trade is carried on at almost all large railway stations in the orange season.

Mr. G. Stevenson, Deputy Commissioner of Sylhet, has very courteously furnished me with the following statistics of the trade in the Sylhet orange, called in Bengal *kàmala lemboo*, it is said from the name of one of the rivers, in the vicinity of which this orange is largely grown :—

	Boat Traffic.	
	Quant. in Mds.	Value in Rs.
1880–81 . . .	1,20,398	2,40,796
1881–82 . . .	1,46,592	not known.
1882–83 . . .	1,02,631	1,28,288
1883–84 . . .	1,14,969	2,27,062
1884–85 . . .	1,20,884	2,47,352

This averaged about 1,21,095 maunds of oranges per annum, worth from 1¼ lacs to 1½ lacs of Rupees, in favourable years. These statistics only deal with exports to Bengal, and mostly to Calcutta. No account is kept of oranges consumed locally, and in the immediate surroundings of the orange groves.

Mr. J. D. Anderson, Officiating Deputy Commissioner of Sibsâgur, Upper Assam, further states that this orange is also called *sumthira tenga*, and that the traffic is carried on first by the *bàrki* boats of the hill streams, and then by the larger country boats of the *bepàris*, who take them to Dhàka, and Goalundo. From the latter place they are, I believe, railed to Calcutta.

Mr. C. Brownlow, writing in the Journal of the A.H.S of India (part iv., new series, vol. i. 1869, p. 372), on the orange groves of Shalla, says that the trade of this district in 1869, was in limestone, oranges, potatoes, India-rubber, and other minor articles. The oranges came from Shalla. The orange mart is at Chattuck, or South bank of the Soorma river, and directly opposite to the mouth of the Shalla river (a tributary of the Soorma). The custom was to count the oranges in fours, and 750 fours made a *sou* of 3,000, and the prices were so much per *sou*. Rain

is injurious to the fruit when in bulk. It then soon moulds, and goes bad. This keeping property is important, as far as the Calcutta trade is concerned. So that the finest oranges, with delicate thin skin, are mostly kept for local consumption, as they don't bear transport well. Even of the thicker skinned ones, which are sent to Calcutta, a certain percentage rots as they are sent in heaps in boats. No mode of packing was used to prevent them from spoiling on the way.

The oranges at the "Phalli" Bazar were of inferior quality (as far as keeping properties were concerned), being thin-skinned and small, but of exquisite sweetness and flavour. They were, therefore, all sold locally and quickly. At the *ghât* their price was Rs. 6 per *sou* (3,000), being less than the Shalla oranges, at the groves, and yet in the case of the "Phalli" oranges, Rs. 6 includes the labour of cultivation as well as carriage, at the rate of ten men to a *sou*. A Khasia reckoned his labour worth 8 annas per day, and as only half his day must be reckoned, the remaining half being occupied with victuals, it would appear the oranges might be sold at the *poongees* at the rate of about 15 for a pice. Mostock is immediately above Shalla, at about 1,000 feet elevation. Mr. Brownlow got very good oranges there at eight for a pice. From some of the *poongees*, as well as from the Mhowmloo Valley, oranges are carried to Cherrapoongee, where, when in season, they sell at five to eight for a pice, and are of a delicious thin-skinned variety. At Cherra, they may be had a month or more after they are out of season. These late oranges, which are much relished by some, sell sometimes at one pice* each.

From 1869 to date, I have no other information

* A pice is about one farthing.

about the trade in the so-called Sylhet oranges, except that kindly sent by Mr. G. Stevenson from Sylhet, previously given.

"Buxa Dooar" is another place where fine oranges are grown. I have seen specimens of the Buxa orange, kindly sent to me by the Surgeon in charge of that station, at the request of Colonel Rutherford, commanding the 33rd Regiment N.I. The Buxa oranges are of the *sùntara* race, and as good as, though not better than, those of Sylhet. I have no statistics, if there be any, of the trade in Bhootan oranges.

We come now to the borders of Nepâl, north of Goruckpore. Beyond the Raptee and within the Nepâl border, there is a place called *Bootwal.* In this district a small orange of the *sùntara* type grows. It is the sweetest, although the smallest of the *sùntara* race, excepting the *kumquat*, one of the specimens sent from Buxa, was not unlike the Bootwal orange in size.

Major Buller, District Superintendent of Police in Gonda, Oudh, has been good enough to send me the following information regarding this interesting little orange :—

"A head constable of mine says that he had a *kohar* once, who had visited Bootwal. This is the name of a large town beyond the Raptee. It gives its name also to a *kergh.* The orange is called *sùntolah* and is not known in Nepal under the name of Bootwal orange. The orange trees grow wild, not in the valley, but on the hills. However, the hills are all parcelled out between different persons, and although the fruit trees are not in any way cultivated, the produce cannot be plucked and sold by any one, except the owner of that particular plot. The oranges are brought down and sold at bazars, on market days,

in towns adjacent to our territory They are bought by *koònjras, kòhars,* and other dealers, and by them taken to Goruckpore, Bustee, Fyzabad, Benares, &c.

"Dr. Cameron's *mali* in Gonda, says that this orange is called *suntowrea,* and that it is grown at Bootwal, and there alone.

"I met a havildar of the 1st Goorkha regiment. He confirms what I told you about the *sùntolah* orange. It grows wild in the *hills,* and not in the plains of Nepal, the Raptee valley, &c. By cultivation, the orange becomes sweeter, bigger, and has a thinner skin, otherwise the wild and cultivated oranges are one."

This small sweet *sùntolah,* orange from "Bootwal," was hardly known beyond Goruckpore some time ago, but now, since the railway has been opened north of the Ghagra, this curious little wild, and very sweet orange, averaging about 6¼ inches in girth, has found its way to Benares, and no doubt, in time it will reach other places. Kumaon also, has some local trade in oranges.

Next to Sylhet, and its vicinity, the largest centre of orange trade is Nagpore and its surroundings, in the Central Provinces. Mr. J. B. Fuller, states that "this orange is the great speciality of the black soil country in the fruit line."

In my opinion the Nagpore orange is the best flavoured of all the *sùntara* type of oranges, and Mr. Fuller thinks it is "decidedly the best of any which he has tasted in India." That from Bootwal is sweeter, but many think it is too sweet, and that a mixture of sweetness with sufficient acid to make an agreeable flavour, such as that of the Nagpore orange, is preferable. The Bombay market is largely supplied with oranges from the Central Provinces, and there is

probably little doubt that the black soil of those Provinces has a great deal to do with the fine flavour of the *sùntara* orange grown there.

Mr. J. H. Fisher, C. S., collector of Etawah, who had been, at one time stationed in the Central Provinces, has kindly given me the following information.

"It is now ten years since I was in the Nagpur and Chattisgurh Divisions of the Central Provinces, and so I speak from memory. In the Wardha district, as in Nagpur, there were a good number of large orange groves, the produce of which was sent down to Bombay. The tree there ripens fruit twice a year, in the late autumn, the crop being called, *amhà bar;* and in the late spring, when it is called *mìrrik bar.** The trees thrive prodigiously in the rich black soil of the country, which being decomposed trap rock, is highly calcareous, so that they get the lime that the whole tribe of citrus so delight in. The orange groves are planted not only near the railway, but at considerable distances from it. I remember some in the *Arvi Tehsil* of the Wardha district, and also in the *Sausar Tehsil,* in the south of the Chindwara district. The groves that I remember were planted out in the open, without reference to any shelter or protection from large trees.

"When I was in camp in 1873, in the South-east corner of the Raipur district in the zamindari of Khariar, I remember the Rajah of Kalabandi, a feudatory state in the neighbouring district of Sambalpur, coming to see me. He brought with him some huge baskets full of oranges, the produce, he told me of wild orange trees, which grew in certain places in the forests on his estate. As they were out out of my district, I never had an opportunity of

* This is the *Dumrêz,* or after crop of other places.

seeing these wild trees, and forming an opinion, as to their origin, *i.e.*, whether they were really indigenous, or were the descendants of trees brought from elsewhere. In any case, the oranges, though not so large as the cultivated variety, had the same characteristics as the Nagpur orange, and were very sweet.

"When at Chindwara in 1876, I imported (with vines, olive grafts, figs, and mulberries) some varieties of oranges from Naples. One or two of the plants I took with me to Jabulpur in 1877, and left them there in 1878. The others remained at Chindwara. Whether any of these trees have survived the changes of district officers that have since taken place, and established themselves in these districts, I know not."

The Nagpore orange is locally called *sùntara* by natives.

Mr. J. B. Fuller, has courteously furnished me with the following statistics of the orange trade of Nagpur. "Within the last twelve years many new orchards have been planted in Nagpur, Kamptee, and other parts of the district; and orange cultivation is now spreading rapidly in other districts of the province.

"There is a great demand for the Nagpore orange in Bombay, and considerable quantities of the fruit are annually exported to this and other places. In the year 1885, 22,609 maunds of orange fruit were exported from the Nagpur station, out of which 21,400 maunds were exported to Bombay alone."

This paper was drawn up by the Superintendant of the Government garden of Nagpore.

In addition, Mr. H. J. P. Thomson, secretary to the Great Indian Peninsula Railway Company, has been good enough to furnish me with the following particulars of the traffic in oranges from Nagpur, during 1885:—

	Maunds.
By goods trains	4,326
By passenger trains	22,512
Total	26,838

Delhi and its surroundings is, as I said, another centre of some orange trade, but it appears to import more than it exports. The *sintra* or *rungtra* orange of Delhi is sufficiently well known. It is a baggy, loose-skinned orange, usually without much pretension to symmetry of form. Mr. George Smith, the Deputy-Commissioner of Delhi, has kindly favoured me with the following statistics regarding the orange trade of that district. The memorandum was drawn up by the Tehsildar of Delhi.

"The *rungtra* orange of Delhi is exported to Meerut, Jeypore, Bombay, and to some other minor places. About 200 maunds are exported per annum, valued at 1,600 rupees, or eight rupees per maund.

"Then from Ulwar, Nagpur, Gurgaon, and villages across the river Jumna, about 2,000 maunds are imported into Delhi, valued at about 24,000 rupees, or 12 rupees per maund."

The latter figures appeared doubtful. I referred them again to Mr. Smith, who said they were correct, the imports being made at a later period, when oranges fetched a higher price.

I have seen the orange gardens of Delhi. The whole system of orange cultivation there is faulty and slovenly.* With its fine variety of *sùntara*, its good soil, canal irrigation, and railway communications, Delhi ought to export *more* than Nagpore. While the latter exported over 26,000 maunds, the former only exported 200 maunds, and *imported* 2,000 maunds.

* See Chapter XI. on "The Cultivation of the Orange—Delhi Gardens."

Although all these oranges are of the *sùntara* type, they are different varieties. The Sylhet orange raised from seed does remarkably well in Lucknow, while that of Delhi does very badly there. Of two Nagpore varieties, one does fairly in Lucknow, the other produces nothing.

We have then the Sylhet orange, *kamlà lemboo*, the Bhootan orange, the Bootwal, or *suntolah*, or *suntowrea* orange, the Nagpore orange, and the *sintra* orange of Delhi, all *varieties* of the *one* type of orange, the *sùntara* of moderns.

This type of orange is found in many other parts of India, and also in Ceylon. In Lahore a pretty pear-shaped variety is grown under the name of *karna* or *sungtara*. In Mooltan another round variety is also called *sungtara*. A variety grown in Poona is called *sùntara*. In the Shevarays another curious variety of the same type goes by the name of "Country orange." In Yercaud it is given the native name of *kolinje*, and about Madras, *kitchlee*. This information I obtained from Dr. G. Shortt, who very kindly sent me a specimen of this interesting "Country orange." I was informed that in Canarese the orange is called *kitlè hannoo*. The Western Coast of India, South of Goa, is supplied from Coorg with an orange of the *sùntara* type. In Ceylon they have a *kònda nârun*, almost an exact copy of the Nagpore orange, although of a different variety; and a larger variety called there *jàwa nârun*. In Kandy the latter is smooth, but in Colombo I found some sub-warty, with a more pronounced pear-shapedness. Somehow these *sùntara* oranges of Ceylon have got the name of *mandarin* oranges. None of the above, however, is *true mandarin*, although the latter is *allied* to the *sùntara* type of

orange. Any one, having once scented the leaf or the rind of a true mandarin orange, can always recognise it again.*

The *kònda nârun* of Ceylon, which, as I said, is much like that of Nagpore, is eaten always in its *green* state. It could be found in the markets of Ceylon during all November. It had not an unpleasant flavour, but appeared to be unripe. Some said, however, that it is better flavoured in its green state. It is so habitually plucked, sold, and eaten in its green unripe state, that the people there may have come to look upon it as a *green* orange *which never turns of an orange colour.* As I had never heard of a green orange, and as I did not believe in one, I bought two dozen of these green *kònda nârun.*† On leaving Kandy on December 11th, I wrapped each in a bit of newspaper, and packed them loosely in a covered bamboo basket. They travelled with me from Kandy to Colombo by rail, crossed the channel to Tuticorin on the 19th, and travelled all the way by the South India Railway, Madras, G. I. P. and E. I. Railways to Etawah, where I reached on January 1st. On opening the basket, I found only *one* spoilt. All the others were either turning or had turned yellow. I kept them till January 20th unpacked, when I took them out of their papers, and all had turned of a yellow-orange colour, and only one more had spoilt in the meantime. All the rest (twenty-two) were sound, and of a nice flavour, and juicy. I sent some to Mr. Ridley, Lucknow, who found them also very nice. It would appear, therefore, that the *green* orange has no

* For the probable origin of the true mandarin in Ceylon, see Chapter VI., on "The *keonla* and mandarin Group."

† Rumphius, however, mentions a similar orange which is eaten while green.

*locus standi.** The fact is, in Ceylon, not only the orange is gathered unripe, but *all other fruit.* I was never more astonished than when I visited the Ceylon markets.

All the fruit I found was unripe. Even pine-apples, which ought to be the glory of Ceylon, were unripe, and worse flavoured than those grown in Philibeet. The only fruit worth having, then, was the plantain, and this is one of the few which can be gathered in an unripe state and hung up to ripen, without losing much flavour, although if cut too early, this also will lose flavour.

It should not be supposed, however, that people in India are innocent of the vice of gathering fruit in its unripe state. They everywhere do so, more or less—1*st*, because sometimes it pays them better to do so; 2*nd*, because the longer they leave it on the tree, the longer they have to watch it; 3*rd*, if they do not watch it, it is likely to be stolen, or eaten by parrots, monkeys, &c. In the Etawah Jail Garden, the purchaser of the fruit gathered all the Malta oranges in October, in their *green* state. There was a *mêla* (fair) on, and he said he could get a good price for them. The palate of the people of India has been spoilt, because they have rarely had a chance of tasting a delicious fruit, *well ripened on the tree.* The mango and the plantain are perhaps exceptions, as they can be ripened off the tree, and retain their flavour if not plucked *too early*, although they often spoil mangoes also by endeavouring to bring them too early into the market. If a fruit is plucked *just before* it ripens, then its own freshness enables it, off the tree, to continue the change to full ripeness.

* It may probably be a variety which is *late* in taking on colour. The Nagpore variety, I think, colours *earlier.*

Besides oranges of the *sùntara* type, which are smooth, and of a yellowish orange colour, there are those called *naranghi* and *keonla*. The latter word appears nothing but a modification of *kamla*. They are both redder, rougher, and usually smaller than the *sùntara* orange, otherwise they are much of the same shape and size. Moreover, they have often a flattened mammilla on the apex. Natives make a distinction between *naranghi* and *keonla*, but I could not find any distinction. If there be any, it is that some *naranghi* are sweeter than the *keonla*. The latter, in its unripe state, is very sour, and unless thoroughly ripened on the tree, or, as some say, off the tree, it is hardly edible. By December and Christmas time all the *sùntaras* are gathered. They are left so long on the trees, because they fetch a good price during Christmas week. But they would, as a rule, improve vastly in flavour if left on the trees for another fortnight or three weeks. Some varieties, however, if left too long on the tree, dry up and become juiceless, especially if the trees are not watered.

The *keonla* sweetens later, and is therefore better for being kept on the tree till the end of January and later; so that it comes in as a late orange. It does not appear, however, in great favour, probably on account of its sourness. It is, nevertheless, a good cropper. It is found everywhere, but I am not aware that there is anywhere in India any centre of great trade in the *keonla* orange, as there is in its more popular sister—the *sùntara* orange.

Besides the foregoing type of orange, there is another, and a totally distinct one. It is larger and closer-skinned, and with a totally different flavour. I mean that of the Malta orange type. Although I

have found oranges of this type in many parts of India and Ceylon, there does not appear to be anywhere any special trade in this kind of orange. As I have written fully of these in another chapter, I need only enumerate their varieties here, viz., the *pènidòdan* of Ceylon; the *bandir* or *chinee*, and "Spanish" oranges of Tanjore; the *Mussèmbi* of Poona; the Malta and *paenbagh* oranges of Lucknow; the Suez, and blood-oranges of Jaunpore; and the famous blood-orange of Gujranwàla. All these are of the Malta or Portugal sweet orange type.

Although India has so many fine varieties of citrus, and so many different climates and soils to grow them in, the reader would perhaps hardly believe that Bombay imports oranges and lemons from Africa and Arabia.

Mr. Moore, the Acting Commissioner of Customs, Bombay, has very courteously favoured me with the following statistics regarding the imports of oranges and sweet lemons from Zanzibar and Muscat. The figures for 1885–86 are from 1st April to 22nd March, 1886.

	1884–5.	1885–6.
	Rs.	Rs.
Zanzibar Oranges	1,743	836
Muscat sweet Lemons	1,555	1,695

Although the Séville orange is to be found in many places, both in India and Ceylon, there is no demand for it. It makes the best marmalade. Who knows how many tons of tinned marmalade are imported annually from England?

The Mandarin orange is only suited to moist climates, where hot winds do not prevail, such as Bengal, the Western Coast and Ghâts, Ceylon and

Burma. There is no reason why Ceylon should not supply Bombay and Calcutta with this delicate orange. It has only to be made known for a demand to grow up.

The *khatta* orange is mainly utilized for its seeds. They are sown in most places for the purpose of raising young stock to bud on. It appears, however, that seedlings of the sweet lemon ought to replace it for budding sweet varieties on.

There now remain the pummelos, citrons, limes, and lemons.

The best pummelos I have seen are the thin-skinned red pummelos of Bombay. They come in about Christmas, are juicy, and of the colour of *raw beef* internally, and of globose shape. There is no reason why this fine kind should not be extensively grown. All the other varieties of pummelo I have seen in India and Ceylon are not to be compared with this, and hardly worth propagating to any extent.

The citrons are very little used, except for medicinal purposes. On the western coast of India they have many large varieties, and at Mangalore they eat the thick sweet skin after peeling off the bitter rind. In Lucknow and in Rampur, Rohilcund, and other places, they make a preserve of the thick skin of the citron, which they call *turunj*. All the citrons, both sweet and sour, have a dry pulp.

From the borders of Nepâl I received a citron-like *khatta* orange, of the size of a small jack-fruit, with a girth of 24 inches, 10 inches long and 7½ inches diameter. There it is called *rus kankur*, *katthairee nimboo*, or *beora*. It had no seeds, a pale sour pulp, and a thick sweet skin, which is the only part eaten. These specimens were sent to me by Major Buller. Mr. Hein, of the Lahore Government

Garden, sent me a smaller specimen of this same variety, which he says is there called *gulgul.*

The limes are the most used. They are to be found everywhere, and where no other Citrus is found some kind of lime is sure to be found. Nevertheless, it is astonishing that so common a thing, so useful a fruit, and a tree so easily raised from seed, is not to be found in *villages* of the N. W. Provinces. There is not a village in the whole of India, perhaps, where the *kaghzi nimboo* would not readily grow.

A large and profitable trade might be made from the sweet lemons. They are much appreciated by natives, and fetch a good price. They call them *sherbetee,* or *mitha nimboo,* and also *amrutphàl.* The best flavoured sorts are grown in dry climates, such as those of Mooltan and Muscat. Bombay is supplied with this *mitha nimboo,* both from Nagpore and from Muscat. From the latter place two sorts are imported. A round one, of the size of the Indian sweet lemon, and a large pear-shaped one. (*Vide* plate 195, fig. *c.*) These sweet lemons are well worth the attention of any one desirous of growing fruit for profit. Natives appear to prefer them to any other kind of Citrus, and give a higher price for them. To the European palate, however, the total absence of a sub-acid is a disqualification, though certainly not in the opinion of all.

The sour lemons, finally, may be divided into *bajouras,* a sort of citron-lemons, with a good deal of sour juice in them ; lemons proper ; and a group of Citrus known by the name of *gungolee* and *behàri* lemons.

Neither of these have I seen in any market except that of Pondicherry. They have there a lemon which appears like the Malta lemon, but smaller. The

French there call it *Citron*, as they do the lemon in France.

The Malta lemon is now known and grown in many places. It is one of the easiest to grow, and has thrived wherever it has been tried; its fruit is one of the most useful for various purposes. No trade in lemons, however, has yet grown up. The *bajouras*, or citron-lemons, on account of their thick skin, are never likely to be much used, except for their peel. On the contrary, the lemon, besides being of a convenient size, has a thin skin, and is full of a fine flavoured acid juice.

In the Punjab they have a large sour lemon, about two or three times larger than the Malta lemon. It is called *gulgul*. It is a very good lemon where a large quantity of juice is wanted at one time, or for making lemon jelly, or bottled lemon juice. They have a somewhat similar one in Kumaon, which is there called "Kumaon lemon." It is also found in Saharanpore, and I have been told that during the month of April it is largely sold in Mussoorie. There are other sour lemons, but they are not common.

All these lemons would keep well if left on the trees, a certain number on each tree, so as not to prevent the spring flowers from setting. Natives are always in too great a hurry to gather and sell their fruit. If left on the trees till the hot weather, especially where there are extensive groves, these sour lemons would vastly increase in value.

In my opinion the Citrus trade of India, although many of its varieties are almost *indigenous* to this country, is absurdly small. It would admit of great expansion, with profit to the grower and the consumer, and now, with the network of Indian railways, there are few places to which they might not be

carried in a short space of time. There is probably no part of India, from the Himalayas to Ceylon, and from Sylhet and Bhootan to Sindh and Bombay, where either one variety or another might not be largely and profitably grown.

As I have shown in the case of the Mandarin and Malta oranges, every soil and every climate will not suit all oranges. This is a great advantage, as every soil and climate would create a speciality of one or two varieties of citrus, which would be *best suited* to that locality. In this way the varieties would not compete with each other and flood the markets with the same kind, at the same time. I may here sketch a sort of geographical distribution of the various kinds of citrus which now find favour with the public, and of others which should be more widely known ; but of course this sketch is very imperfect.

Gujranwàla and Jaunpore might grow, with advantage, the late blood and other Malta oranges; Kumaon its "Baghèshwar" orange ; Nepâl its sweet little *suntolah* orange, and the little known Nepâl lemon ; Bhootan and the Eastern hills, the *kamlà lemboo ;* Delhi, Nagpore, and Ceylon their own fine special *sùntara.* That of Ceylon is the *green* orange, which travels so well. Bengal, Ceylon, and West Coast of South India and Burma might probably grow the delicate mandarin. Tanjore might largely grow its fine *bàndir ;* Aurungabad, Deccan, its fine warty-red *keonla.* Poona might make a speciality of, and improve its flat *laroo,* a kind of *keonla,* and of its furrowed *mussèmbi,* one of the Malta type. Bombay, or wherever it is grown, would do a service if it made a speciality of its fine thin-skinned and red juicy round pummelo, and supplied half India with it. From Mooltan and Sindh would come the best flavoured

sherbetee nimboo, or sweet lemons. Although this can be grown in other places, I do not think it is so well flavoured. Lucknow might make a speciality of its fine large *behàri nimboo*, and its *kaghzi kalàn*. In this locality also grow well the seedling Sylhet orange, and the *paenbagh* orange of the Malta type. And Lahore has its pretty pear-shaped *karna*.

The large sour and juicy lemon, called *gulgul*, grows well in the Punjab, Kumaon, Saharunpore, and on the borders of Nepâl, and would probably grow well in many other places, as I saw it growing well in Benares. Finally, the Malta lemon and the different varieties of true limes appear to grow well all over India; and as they are very useful, both medicinally and for various domestic purposes, it would be a great advantage to grow them, not only in every city and large town, but in every village in every part of India.

By restricting the varieties to be grown on a large scale, to those most suited to a particular locality, a race of growers would be trained, who would thoroughly understand the wants of that particular variety, and would grow up from their childhood thoroughly conversant with the best mode of dealing with it, both with regard to pruning, propagating, and cultivating it generally; and the best mode of packing and keeping its fruit for a long time. The secret of profit is to watch the markets and not flood them with all kinds at the same time, as natives often do.

Then for carrying the oranges, lemons, &c., from place to place, quick steamers are wanted, good coal in India for the return journey, and refrigerators. Perhaps petroleum fuel may yet be cheap enough to be used extensively as a fuel. Then as Indian wheat competes favourably, in the European market, with

American wheat, so might, not impossibly, Indian oranges, of a dozen different varieties, compete favourably with Florida, Trinidad, and Brazil oranges.

Excluding Europe, however, there is looming in the distance an opening for an extensive trade in the oranges and lemons of India. The Russians are hurrying on their railways from the North, and the British from the South-east. These two railway systems must meet sooner or later, because it will probably be the interest of both empires to make them meet. When that time comes, the orange and lemon trade of India should receive a great impetus. The Russians are great tea-drinkers, and their favourite mode of drinking tea is with a slice of lemon with sugar, and the hot tea poured over them, without the use of milk. This Russian mode of drinking tea is extremely nice, especially in the hot weather. Now supposing each Russian used one lemon per day, it can easily be seen what a vast number Russia would consume. The Central Asians are also great tea-drinkers, and they will not be slow in adopting the Russian mode of drinking tea with a slice of lemon; so that the future prospects of the lemon trade of India are not at all bad.

But, again, leaving the foreign trade entirely out of the question as chimerical, there is no reason why the *internal* trade in oranges and lemons all over India should not be largely developed; and there appears no good reason why with management the supply of oranges should not be kept up from December to July, considering the many fine varieties that India possesses. Then some sort of sour lemon, lime or orange should be procurable all the year round. In Italy the time lemons are most used is in the summer, for making *granìta,* or iced lemonade. And there is

no doubt that India, with its numerous varieties of sour citrus, could supply its internal trade all the year round. To effect this, cheap and quick railway transit for fruit is needed. A waggon or two for fruit might perhaps be attached to mail trains, and fruit carried at the cheapest *goods* rates. Thus convenience and advantage to everybody might be the result. There is also no reason why in each passenger train fruit sellers should not have a stall in one of the third-class compartments, wired in to prevent stealing. In my opinion enough sensible use is not made of passenger trains.

The following will show to what distance fresh fruit can be carried, provided it is sound and carefully packed. In the *Gardeners' Chronicle*, of March 6th, 1886, p. 306, under the head of "Fruit from the Cape," the following occurs :—"Messrs. Webber and Co., of Covent Garden, last week received a small consignment of pears—Louis Bon and Beurré Superfin—in splendid condition, after a voyage of 8,000 miles. They anticipate in the future from the same source a regular supply of various sorts throughout the spring months."

Then, during the Colonial Exhibition in London, it is stated that from Australia, apples, pears, oranges, grapes, &c., &c., arrived in excellent order in London weekly.

From an experiment I have myself made, I found that the *kònda nârun* of Ceylon stood a long journey very well, even packed in a very rough way.

Finally, some lemons sent to me from Mr. Stalkartt's garden in Calcutta stood the following journey perfectly. First they were sent to me in Etawah ; I examined them, repacked them, and sent them all the way to Bangalore, *viâ* Bombay and Madras.

I sent dozens of Malta lemons, simply wrapped in common paper and packed in boxes, to Lahore, and to the interior of the Himalayan mountains. They all reached their destination in perfect condition.

It is a wonder to me that ships continue to take unpalatable lime juice in bottles, when they could take fresh lemons or limes, packed in this way, which would remain in a good condition for a long time, and if kept in a refrigerator they might possibly be taken all round the world without being damaged. But as either lemons or limes are now found all over the world, a ship might replenish its supply of these fresh fruits every fortnight or twenty days. India especially has a great variety of citrus of a large size, which, owing to their thick skin, would probably travel better than any others, such as the *amilbêds*, *gulguls*, Kumaon lemons, *khattas*, and so-called *sour pummelos*. If some one would undertake to make some experiments with these large sour and juicy citrus a new opening might be found for them. Instead of taking a bottle full of unpalatable lime juice, a large citrus full of nice fresh sour juice would be taken. Even in the time of Rumphius, when there were only sailing boats and ships, both the lime and the pummelo were taken on long voyages, as they kept well.

CHAPTER XIV.

MORPHOLOGY OF THE CITRUS.

"Without some reflection it will appear all rubbish; perhaps it will appear so after reflection." CHARLES DARWIN.

IN this chapter I have attempted to give form to various ideas which arose in my mind while studying the numerous cultivated varieties of oranges, lemons, &c., of India. I have attempted to show the changes, according to my views, which the citrus might have gone through, and the devices, so to speak, it has resorted to, in order to "struggle for its existence," and to push itself into notice, and into the position it occupies at present. Some parts of this chapter are to be found in text books, being accepted by botanists; others, however, are in no way endorsed by botanists, and are mere speculations. I have hazarded also a speculation on the embryology, so to speak, of the citrus leaf, which, next to its fruit, is the most interesting object of study.

In Appendix, No. 62, will be found an endeavour to explain why the sides of the pulp carpels are usually free of juice vesicles, and in Appendix, No. 39, will be found extracts from Dr. Masters' work on "Teratology," which in many places appears to strengthen my view. (*Vide b, c, f, i, j, l* and *m* of Appendix, No. 39.)

In order that the general reader may understand what I say about the morphological history of this in-

teresting genus, as I view it, I shall have to begin at the beginning.

The citrus tree, like many others, commences its existence by a bud, which is protected from external influences by the seed shells or coverings. It is also protected against starvation during its infancy, and until it perfects its own organs of nutrition, by a small store of food enclosed within the same shells in what are called the cotyledons. Under certain circumstances this bud germinates and starts into growth. Even at this early stage, the stem of the young citrus and its first leaves are studded with essential oil glands. As we shall see in another place, these oil glands may be of importance to the adult plant, but I am not sure that they are not a disadvantage to it while it is a young seedling. Anyhow, I suppose, like all of us, plants and animals, we must make the best of what means we happen to possess, in order to compete successfully with other individuals.

It would appear that the leaf of any plant is simply an expansion of the bark. The leaf of the citrus is studded with two or more sets of oil glands, viz.: large ones at certain distances, the intermediate spaces being filled with secondary and tertiary oil cells, as shown in pl. 181, fig. *a*. This arrangement is universal, whatever the variety may be. The edges of the leaves are crenated, that is, shaped like little festoons. In a well developed leaf, the big crenations have smaller crenations. The angles formed by the big crenations have each a large solitary oil cell, and the angles formed by the smaller crenations have each a smaller oil cell also. In many orange leaves these crenations are found only towards the tip half of the leaf. In the citrons, lemons, and allied varieties they often commence close to the petiole. There is such a thing, however, though rare,

as a variety with most of its leaves without any crenations, although the oil cells at the edges are not extinct. These would appear to mark the position of the crenation angles. A tree of the same family, the Feronia elephantum (kaithà) has the oil cells sometimes *only* at the *angles* of the crenations, and none visible on the blade of the leaf. These crenations or serrations, whatever botanists may like to call them, I take to be simply abortive *leaflets*, and the angles between them I take to mean the abortive *axillæ* of those leaflets.*

There is a most interesting little plant (Bryophyllum calycinum), called by some natives *ghao-patta*. On the edges of its leaves it has large crenations, with what I would call *secondary axillæ* between them. In these secondary axillæ are dormant buds.† In old Byrophyllums these buds can often be seen developing into little plants with roots and leaves, while the parent leaves are still attached to the plant. These leaf-bud plantlets, detached and put in the ground, will grow into individuals similar to the parent. They are, in fact, simply *seeds* without the seed-*shells*, and as they begin to germinate before they are separated from the parent leaf, they have no need of the stores of food called cotyledons, or of the protecting seed shells. In fact, the parent leaf performs in this case the function of cotyledons. In other words, they might be considered as rooted buds, developed from the axillæ of the abortive leaflets—the crenations.

Now, the simplest form of fruit is, I think, that of the pea we eat. The pea-pod is a leaf folded over itself, with its edges united together. From the axillæ of its crenations (apparent or not) the seed buds are developed, each being provided with a small store of food and a shell to protect the whole. In this case

* *Vide* Appendix, No. 60. † *Vide* Appendix, No. 39 (*b*).

a store of food and a protecting shell are needed. The seed bud does not germinate while it is still attached to its parent leaf, or carpel, and without such protection, it would perish before it came under conditions which would enable it to start into independent life. These seed buds, with their little store, are the peas we cook.*

The leaf of the Bryophyllum calycinum, however illustrates a stage of fruit development *anterior* to that of the closed pea-pod. It is a fruit which has not yet evolved the habit of folding itself up into a pod for the protection of its buds while young, but remains expanded and produces its peas, or seed buds, at the axillæ of its crenations.

Having premised the foregoing, we shall now, perhaps, be better able to understand the composition of the fruit of the Citrus—say that of an orange. I had stated before that the orange leaf is an expansion of the stem bark. In the Citrus, from the normal axillæ of the leaves two or more buds are produced, which either become regular fully-developed branches, or remain abortive and become what are called the *spines* of the Citrus.

The flower is nothing but a transformed branch, either coming out of the axilla of an ordinary leaf or from that of an abortive leaf, usually called a bract. This transformed branch, or flower, in the orange, consists of several whorls of transformed leaves, viz., the calyx whorl, the corolla whorl, the stamina whorl or whorls, and the ovary whorl or whorls.† The latter, in the Citrus fruit, I take to consist ordinarily of two

* I am aware this is elementary matter, but the general reader may, nevertheless, not know it.

† It is considered that the parts of fruits in general are transformed leaves, called carpels.

distinct whorls*—the outer, or *rind*-whorl, and the inner, or *pulp*-whorl. The two combined form the orange, or lemon. They are best examined in a ripe fruit.

Usually the outer covering of the orange or lemon, in my opinion, consists of a whorl of carpels, united so well together by the whole length of their edges, that, in many cases, they appear one uniform and continuous protecting case. The rind of the Citrus, however, is not always so even as we see it in a "sùntara" or Portugal orange. For instance, sometimes the joinings of the carpel edges remain remarkably distinct, such as in the following specimen, taken from Risso's monograph, "Bergamottier mellarose" (pl. 241, fig. *c*), and also in a number of citrons proper.

This fruit, besides distinct carpels, agglutinated together, exhibits also an extra and inner whorl of rind carpels round the apex. Almost all the Bergamottes illustrated by this author have the joinings of their carpels quite distinct. The fruit of the double-flowered Bergamotte (pl. 241, fig. *a*) is another example of the persistence of distinct carpels. Several others might be quoted. The following, however, are perhaps more convincing. They are also taken from Risso's monograph. They prove that the ordinarily uniform and smooth Citrus rind is nothing but an agglutination of originally distinct carpels. Fig. *g*, pl. 240, is the fruit of the "Oranger à fruit cornu." Here we have one of the carpels insisting on remaining separate, and only partially united to the rest. It sticks out like a horn on the side of the orange. All the fruit of that variety were horned like this, some more, some less prominently so. Every large appendage of this sort had a separate pulp carpel within it. A

* Botanists do not admit that the Citrus fruit consists of *two* whorls; but further on I have given reasons for considering it so.

still more interesting specimen, from a morphological point of view, is that shown in fig. *c*, pl. 240, which is the fruit of the "Bigaradier à fruit corniculé." The surface of this Citrus has many horns, indicative of a greater tendency to separation of the carpels. The section shows three distinct pulp carpels, belonging to the three larger horns. The "Limonier à fruit digité" gives a still more striking example in fig. *a*, pl. 178. So do the fruits of the "Chhàngurà," or digitate citrons of India and China, shown in fig. *a*, pl. 139 and fig. *a*, pl. 140. The digitate lemon shows a single whorl of rind-carpels only, the pulp whorl being suppressed, according to Risso, while the digitate citrons show an outer rind whorl and an inner whorl, *also of rind carpels*, indicating, I take it, a very remote stage in the history of the Citrus fruit evolution. The inner whorl of carpels, which in the perfect fruit forms the pulp, I consider is here still in the *crude condition of rind.* By their reversion to what I consider ancestral forms, these interesting digitate fruits give us, I think, a glimpse of some of the stages through which the Citrus may have passed in evolving the pulp carpels, and, by continued selection, eventually becoming the fine fruit we now cultivate.

Double flowers are often produced by the growth of additional whorls of petals. So in my opinion, are double, and even multiple citrus fruits produced by the development of extra whorls of carpels. Risso, in a specimen shown in fig. *a*, pl. 241, gives an extraordinary example of carpel multiplication in the citrus fruit. It is the fruit of the "Bergamottier mellarose à fleur double." To begin with, in this example, the rind carpels are all distinct, and ununited at their distal ends, where they form a sort of rim of a cup, out of which, an inner series of rind carpels protrude,

like the bracts of an artichoke. The section (*b*) of this fruit shows a most complicated structure. Within the outer rind, is the usual whorl of pulp carpels; within each of these is a double series of both rind and pulp carpels (*b′*), each pair forming miniature elements of another complete orange.* Within this circle again are imperfect carpels, some having rind attached with essential oil cells, as at A. Then in the centre of all is a ring of simple rind carpels, with essential oil cells. Not only is the flower of this singular tree double, but its fruit is also *very* double.

What formerly were supposed to be examples of "superfœtation," appear nothing but specimens of fruit-doubling. The peculiarity of these fruits exists in the ovary *before* fertilization, and the fruit exhibiting it, may develop *without having been fertilized.* Fig. *a*, pl. 240, is an example of what Risso called "Bigaradier à fruit fétifère." Its fruit however appears nothing but another specimen of fruit *doubling.* It had rarely *any seeds,* and, when present, they were very small and imperfect, and the fruit of the "Bergamottier mellarose à fleur double" had no trace of seeds. Such instances of seedless fruit plainly show that this so called superfœtation, could not have been the result of excess of *fertilization*, as there were no germs to be fertilized, and had there been any, they must have been so imperfect that no fertilization could take place.† The "orange sans pepins," and others, are similar instances of an orange growing, and having abundant sweet juice, without its ovules having been *previously* fertilized. The orange is not the only fruit

* These *inner rinds*, in my opinion, all but prove the double whorl nature of the ordinary orange.

† This result of course, might also occur from imperfection of the sexual organs.

which grows and attains perfection without its ovules having felt the stimulus of fertilization. All the cultivated varieties of plantains are usually so. I have also seen a variety of mango, the *surka* of Lucknow, in which the kernel of the stone was not developed. The currant, and the Sultana raisins, are in the same category. All such seedless varieties of fruit in a state of nature, would be at a great disadvantage, and if they appeared at all, would eventually be extinguished, unless perhaps, as in the case of the plantain, the parent plants may have been aided by other means of propagation. On the contrary, under cultivation, such varieties become very important and useful, provided the tree, as in the case of the citrus, can be propagated in any other way than by seed. Cultivation can vastly improve seedless varieties. They are the result of cultivation and selection.

To recapitulate then, this orange within orange appears to be nothing but a *doubling* of the fruit, or ovary-whorls. It is analogous to the doubling of a flower. Risso says that the "Bigaradier à fleur double," if left to itself and not highly cultivated, loses by degrees the character of giving double flowers, and bears only single ones.

Now we have to examine the curious essential oil glands which pervade almost every part of the citrus tree, and which are present in all varieties. The essential oil differs in scent and quantity, according to variety. If you take a leaf of any citrus, and, putting it up against the light, examine it with a lens, you will, as I have mentioned, see a sort of firmament, studded with stars of the first, second, and third magnitudes—possibly other magnitudes also—but usually *three* sizes of cells are quite distinct. These are the essential oil cells or glands. It should be noted that the larger ones

are at certain distances from each other, and that the intermediate spaces are filled with smaller and smaller oil cells. What the object or origin of these three or more sizes of oil cells can be, I do not know, but this I know, that every leaf of every kind I have examined has this peculiarity, and it is repeated in the *edge* of the leaf, the large oil cells occupying the angles between the large crenations, and the smaller ones, those between the small crenations. It is curious to note that in the rind of many citrus fruits, a similar disposition of large and small oil cells is maintained. This might be taken as another proof that the rind consists of *modified leaves* called carpels. Fig. *a*, pl. 181, shows a new and fully developed leaf of the Malta lemon, full size, thin and transparent. There are on this sketch three sizes of dots, indicating the relative positions of the different sized oil cells. The largest sized ones were less numerous along the midrib. The crenations, large and small, are exact copies of the original, and they also show the three sizes of oil cells.

The outer, or rind surface of a citrus fruit often resembles that of a lump of dough, studded with large and small *pinholes.** It is interesting to note that in cases of large fruit, where the oil cells have plenty of space to develop in, the three sizes are distinct, the larger depressions corresponding to the larger oil cells, the smaller depressions corresponding to the cells of the second magnitude, and those of the third magnitude are represented by little miliary eminences. In short, a longitudinal section of any part of the rind would very closely, in many cases, resemble the edge of the leaf of the Malta lemon given

* If the reader will substitute "foveoli" for *pinholes*, he will have their botanical term.

in fig. *a*, pl. 181. Then in fig. *c*, pl. 209, I have given a portion of the surface of the *sadáphal*, at A. The largest cells are disposed at equal distances, shown by the larger dots, the smaller oil cells occupying the intermediate spaces as miliary eminences (see also pl. 75, fig. *a*, A). In pl. 47, figs. *c* and *e*, are given exact representations of sections of a citrus rind. The larger depressions are the openings of the larger oil cells, and the secondary depressions, the openings of the second sized cells, while the third sized cells are often so squeezed together as to be projected into little *convexities* between the other openings, instead of having each a depressed opening to itself. In small specimens, the third sized cells are either mere points, or not traceable. The only difference between the margin of the rind, and the margin of the leaf, is that in the former, the oil cells are much more developed, and their essential oil differs from that of the leaf.

It would appear this is not the sole relationship between the leaf and the rind. In many cases the *outline* of some of the leaves corresponds closely to the outline of a longitudinal section drawn through the centre of the fruit; and I believe that the mammilla of the citron, close to the stalk, is only a representative of the agglutinated *winged-petioles* of the original carpels, and that the opposite mammilla on the distal end of the fruit may be an agglutination of similar processes in the original carpels. I have come across leaves of citrus, the outlines of which represented at their tips the outline of the mammilla in the fruit.* Therefore in cases where there is no distal mammilla, and the apex is depressed, it is not impossible

* More likely the distal mammilla represents the agglutination of the acuminate ends of the carpels.

that such a fruit was formed by the agglutination of carpels, the originals of which may have been something like *emarginate* leaves. Of these there are many representatives in almost every citrus tree. This, however, might have originated otherwise.

We have still the interesting structure of the citrus pulp to account for.

On one occasion while examining the transverse section of a citrus fruit, it flashed across my mind that the juice vesicles of the pulp carpels were only modifications of the oil cells of the rind. Arguing back from juice vesicles to rind oil cells, and thence to the oil cells of the leaf, I did not see what else the vesicles could be but modifications of the *oil cells of the leaves or carpels;* that is, oil cells transformed to another purpose, viz., the secretion of acid, sugar, and mucilage, or whatever the juice vesicles may contain. Often the juice of a citrus has an aroma *sui generis*, which may possibly have some relation to that of the oil cells of the rind covering. The slight bitterness which some juices exhibit may also be derived from the bitterness of the original inner whorl of rind, from which, in my opinion, the pulp was evolved. In the juice vesicles, we can, I think, also trace a repetition of the large and small cells, although as these are squeezed together, they are often out of shape. Fig. *c*, pl. 154, shows the variously shaped juice-vesicles I took out of one of the carpels of a citrus. The pedicels of the spindle shaped ones I take to be the lengthened *necks* of the larger rind cells, as seen in pl. 66, fig. *b*. Although the oil cells of the rind are usually balloon-shaped, I have met with some which were *pointed*, as shown in fig. *b*, pl. 6, like the spindle shaped juice-vesicles. Pl. 106, fig. *c*, and pl. 124, fig. *g*, show other forms of juice-vesicles, as well as pl. 209, figs. *g* and *h*. Pl.

122, fig. *k*, shows rind-oil cells, which are *larger* than many pulp-vesicles. Fig. *e*, pl. 76, shows a section of the juice cells in a pulp carpel. It gives approximately the same disposition of large and small cells, as that seen in the leaf and rind.

If, however, further proof be required of the relationship between the pulp-vesicles and the rind oil cells, it can be obtained from a genus which is closely allied to the citrus. In fig. *c*, pl. 242, is given a longitudinal section of the pulp carpel of the Œgle marmelos (the *bœl* fruit). The interior surface of its wall is studded with open mouthed cells, which pour out a transparent mucilaginous substance, with which the interior of the carpel is filled. This is the gummy matter of the *bœl* fruit, and is soluble in water. These opened mouthed cells of the pulp carpel of the "bœl" fruit, I take it, can be no other than the homologues of the citrus juice cells on the one hand, and of the rind cells on the other. In the citrus they are closed sacks, and develop, not only *mucilage*, but also acid and sugar; all these three substances, it would appear, might be easily changed from one to the other.*

The view I have taken of the morphology of the pulp vesicles of the citrus is, I think, further supported by fig. *h*, pl. 49. It shows some undeveloped juice vesicles. They are mere projections, tipped with a hair-like point, not unlike the gum-cells of the Œgle marmelos, although in this citrus instead of being open-mouthed, they are closed cells. Moreover in fig. *b*, pl. 66, we have the large balloon-shaped cells of the rind, *pedicelled*, like many of the juice cells. Although the pulp vesicles are often squeezed into all manner of shapes, I think it will nevertheless be seen that they are roughly divisible into *three* grades, like the oil cells of the rind and leaves. This, however, is not of much

* See Appendix, No. 59.

importance, as the juice vesicles, for want of sufficient space, must have naturally expanded in the direction of least resistance. I have given them simply to show that, even in their sizes, there is a certain semblance of uniformity with the oil cells of the rind and leaves. I have in vain endeavoured to discover whether any author has treated of the morphology of the juice or pulp cells of the citrus; but all I can find about this matter is the following in the "Outlines of Classification, and special morphology of plants," by Dr. K. Goebel; at page 420, he says, "Allied to the berry is the fruit of the species of citrus known as *hesperidium*, the pericarp of which consists of a firm tough outer layer, and a pith-like inner layer; from the innermost layer of tissue of the wall of the plurilocular ovary, pluricellular protuberances are developed at an early stage, which gradually fill the cavity of the loculi of the ovary, as isolated closely packed succulent lobes of tissue, and form the pulp."*

The above, of course, does not touch on their *origin* or homology. Are they *new* creations, or a something originally belonging to the carpel or leaf and modified in course of evolution? In the Œgle marmelos we see, what I take to be homologous organs, instead of becoming projections, forming depressions, with their secretions poured into the common cavity of the carpel, instead of being pent up in separate little sacks.

Of course my view would require that the citrus fruit should have originated in *two* whorls of carpels, the outer or *rind-whorl* and the inner or *pulp-whorl*.†

* In the undeveloped ovary the juice-cells appear like hairs, but at that stage they could not appear otherwise.

† This I base mainly on the inner and outer *rind* whorls of the *digitate citrons.*

Sometimes there are many more whorls, as in Risso's "Bergamottier mellarose à fleur double," shown in pl. 241, figs. *a* and *b*, of the accompanying Atlas.

It has been objected that, if the *hesperidium* consisted of two whorls, the law of phyllotaxis would require that their segments should be alternate instead of opposite. To this objection I would reply—(*a*) That the rind whorl has been so altered by selection, that in most cases it has become one *uniform* casing, without *any trace whatever* of the carpel sutures, and where the sutures of the rind carpels are still visible, the fruit has been so altered by increase in the number of its parts, that it is impossible to say now what the order of the two sets of carpels may originally have been (*if* there *were* two separate whorls). Le Maout and Decaisne, "System of Botany" (Hooker), at p. 318, give a diagram of the orange flower, showing 5 sepals, 5 petals, 20 stamens (in five groups of 1, 3, 4, 5 and 7 stamens each), and with 8 *pulp carpels;* and at p. 319 is given a transverse section of an orange, with 9 *pulp carpels.** Unless we come across a wild citrus with 5 pulp carpels and 5 distinct rind carpels (if such a thing ever existed), we cannot say what the phyllotaxis of the citrus fruit may have been, viz.: whether its parts were *alternate* or *opposite*, through torsion, or suppression of an intermediate whorl. The original wild citrus may be *extinct*, and may have escaped our observation for ever. I have seen only one orange—the *kumquat*—which had 5 *pulp carpels* (presumably the original number), and the rind had *no sign* of carpel sutures.

(*b*) There are many instances in which the law of phyllotaxis does not hold good, such as in Dipsacus,

* *Vide* all the sections of all the citrus throughout the accompanying Atlas.

many Caryophyllaceæ, &c.* This is explained by torsion of the stem, or non-development of an intermediate whorl. Is there any good reason, therefore, why this explanation should not apply to the *Hesperidium?*

(*c*) According to Dr. Masters, in his "Vegetable Teratology" (Science of Monsters and Malformations), next to Antirrhinum majus, Aquilegia Canadensis, Brassica oleracea, Daucus carota, Dianthus, Digitalis purpurea, Fuchsia, Primula sinensis, Rosa, Trifolium repens, and perhaps Vitis, the genus *most subject* to monstrosities (in other words variations or changes) in its different parts is the *citrus.*† In pages 33, 35, 44, 56, 75, 134, 137, 149, 303, 310, 335, 364, 453, and 502, Dr. Masters gives examples of variations in the different parts of the citrus plant. However, at p. 75 he states that "De Candolle considers the rind of the orange as a production from the receptacle,‡ and this view is confirmed by the specimens of Duchartre, in which the carpels were quite naked, or had a common envelope truncated, and open above to allow the passage of the styles and stigmas."§

I should say that not only the rind, but all the parts of the orange fruit and the whole flower, are productions from the receptacle, but admitting, for the sake of argument, that the rind has nothing to do with the pulp carpels, and that it is sometimes totally suppressed,‖ or only partially developed, as might occur with all parts of the citrus flower and fruit, there would remain, in consequence, the admission that the *pulp* carpels are *the* carpels. If so, then what has become

* Asa Gray's "Structural Botany," p. 121, par. 236.

† *Vide* Appendix No. 39.

‡ If so, how is it that the oil cells of the rind have the *same disposition* as those of the leaves?

§ *Vide* Pl. 241, fig. *a*, after Risso.

‖ A whole whorl is sometimes suppressed in certain plants.

of the oil cells, which are so constant a character *in all parts of the citrus*—bark, leaves, petiole wings, petals, rind ? My reply would be that they have been transformed into *pulp vesicles.*

I think the digitate citrus, as I shall endeavour to explain further on, gives us some idea of how, according to my theory, the oil cells of the carpels were changed into pulp cells.

This transformation might, perhaps, appear a great stretch of the imagination, but wherever we look, we find that nature has worked her ways with a comparatively small number of organs, fashioning them for all sorts of purposes as she progressed ; here, using the hand for progression only, there for progression and prehension, and afterwards for prehension only, and as an instrument of the mind. In another instance, we find the nose, still an organ of scent, immensely lengthened and becoming also an organ of prehension. The tail, in other instances, has become an organ of prehension, and so on with other parts of the animal organism.

With regard to insects, Dr. Duncan, in his "Transformation of Insects," p. 9, says : "If the skin of a caterpillar, a chrysalis, and a butterfly be examined, the marvellously beautiful cells and hairs of the perfect insect can be seen to be modified epidermal cells, whose predecessors were infinitely more simple and less elegant in the immature insect."

At p. 30, he further states, regarding the silk-producing organs of insects, that "these long tubes form the web or silk-spinning apparatus in the larva ; but after the cocoon is finished, and the first transformation takes place, not only do they become small, but their function alters. The small glands of the perfect insect secrete saliva instead of web, and assist in digestion."

The transformation of the oil-cells of the citrus rind into the vesicles of the pulp would be no more difficult to understand than the transformation of the mandibles of the caterpillar into the sucking apparatus of the moth, which may be several inches long, and, in one case, probably more than a foot long.

In plants the same organ is now fashioned into leaves for purposes of breathing and digestion, then turned into petals and sexual organs, and so forth.

To sum up, my view of the matter is this. The pulp consists of a series of pods or carpels,* folded on themselves and placed side by side, and imperfectly agglutinated together, so that each pod is easily separated from its neighbours. These carpels have their seed edges or crenations turned towards the centre of the fruit, with seed buds developing from the abortive axillæ of their abortive crenations. Sometimes the pulp carpels remain open towards the centre, or are burst open by the expansion of the juice cells like those of the *turunj* in pl. 152, fig. *b*, and others, but usually the two edges are united together and form a regular closed pod, like those of most oranges and lemons. The contained juice vesicles then I look upon as transformations of the oil cells of the rind carpels and homologous with them, and with the oil cells of the leaves and bark.

In studying the relationship between the juice vesicles and the rind oil-cells, I have endeavoured to find support for Risso's theory—that the shape of the oil-cells of the rind (or their openings) was "en rapport" with the *quality* of the juice in the pulp. At page 24 he says: "Nous avons les premiers remarqué

* I have tried to explain elsewhere one way by which their number might have been increased. *Vide* pls. 223 and 224, and also Appendix, No. 62.

un caractère curieux pour distinguer avec certitude une orange douce d'une orange acide, quelque soit la forme, la couleur, et la rugosité de ces fruits. L'orange douce a les vésicales de l'huile essentielle convexes ; l'orange acide les a concaves ; les limes et toutes les variétés à suc fade, ou indeterminé, ont les vésicales planes. Il parait donc que la forme de ces vésicales, ou la qualité de l'huile essentielle qu'elles contiennent, est en rapport avec la qualité du suc renfermé dans la pulpe, puisque plus le suc est sucré, plus les vésicales sont convexes, et plus il est acide, plus elles sont concaves."

It is not clear whether Risso meant that the *openings* of the oil-cells or the *cells* themselves are either concave or convex. Anyhow, the *mitha nimboo* (sweet lemon) of Furruckabad and other places, and the *kalàn kaghzi* of Lucknow, and other places, a thin-skinned sour lemon would, I think, have puzzled Risso. I look upon them as *one thing*, and, as far as I can judge, they are *indistinguishable* externally, while the juice of the former is pleasantly sweet, though not distinctly sugary (what Risso would have called "fâde"), and the juice of the latter is *very sour*. In short, not improbably, the *mitha nimboo* may be a variety of the sour form, in which the acid has never been developed. It is hardly sweet, but *acidless ;* but whether they are so nearly related or not signifies little—their surfaces are indistinguishable. Moreover, in one stage of the sweet orange — the *sùntara* of India—its juice is sour, while in another the juice is a mixture of subacid and sweet ; and when completely ripe, it has little acid. Yet both in its ripe and unripe states, the larger cells have their openings concave, and the smaller ones are represented by minute miliary *convexities*. The *sadàphal* which has scarcely a trace of acid from beginning to end has also the two sets

sets on its surface. Its juice is "fâde ou indeterminé." Finally, the *kuthairee nimboo* has its cells, which are the only ones visible on its lumpy projections, *convex*, while its juice is distinctly sour, and nothing else. In plate 83, fig. *a*, are shown convex oil-cells (B), and concave oil-cells (A), on the *same* fruit.

It would therefore appear that Risso's notion about the constant relationship of the concave or convex cells of the rind, to the acid or sweet juice of the pulp, is untenable.

That there *is* a relationship between the oil-cells of the rind and the juice cells of the pulp, I fully believe, but it would appear only one of *descent*, from a *common stock*—the *oil cells* of the leaves; or to put it perhaps more accurately, according to my view the oil-cells of the bark, of the leaves, and of the rind, and also the juice vesicles of the pulp *have a common origin*, and are homologous.

Closely connected with its morphology is the descent of the citrus. By this I mean the various phases it has passed through, and the means by which it has been able to struggle into the prominent place it now occupies. Of course I can only make an attempt to penetrate its past transformations by means of the lights before me, and a great deal of what I am about to say must be speculative. Nevertheless, from what is before us, we can to some extent argue back to what has past, perhaps for ever, and obtain a glimpse of it, somewhat in the way that the Palæontologist attempts to clothe a few ancient bones with the forms they might have had, by piecing together notions he has obtained from animals now existing. In order to make my thoughts clear some repetition may perhaps be pardoned.

I think we have first to divest ourselves of the idea

that, because there are at present some wild forms of citrus, therefore the cultivated varieties we have at present have descended *directly* from *them.* This may be so, and it is reasonable to suppose that it is so; but it may also be that both the present *wild* forms, and the present *cultivated* forms, have no closer relationship to each other than that they all descended from a *common* and older ancestor, or ancestors, now extinct. Alphonse de Candolle, in his "Origin of Cultivated Plants," thinks that some of the modern cultivated plants have no longer any *wild* representatives; they have become extinct. It must be as easy for birds to carry seeds from cultivated tracts to wild ones, as it is for them to do the reverse.

A writer in the *Gardeners' Chronicle* of 20th June, 1885, on the oranges of the Argentine republic says, "that the orange was originally imported into the basin of the River Plate, and that now, in certain localities, it grows wild, sometimes forming veritable forests, not only on the islands of the lower and upper Parana, but in the forests of Missiores, as well as those of Paraguay." He further says that "the orange is produced perfectly from seeds, and these being scattered everywhere by the parrots, which are exceedingly fond of the fruit, explains the fact of its general dissemination." He adds that "the tree from seed is very robust, and is perfectly proof against drought and locusts."

It should not be supposed that only *sweet* oranges are eaten by birds. In Etawah I have often seen the large fruit of *khatta* orange—a *sour* variety—hanging like a bird's nest on the tree. Only the skin remaining, with a hole on one side, and the pulp entirely scooped out by some bird or other animal.

There must have been a time in the history of vegetation, when plants had not begun yet to form what we

call *seed*, but multiplied only by a sort of division of some of their parts, as inferior animals do, even at the present day, or by what are called *spores*, such as those of ferns and fungi. The latter have the advantage of flotation in the air, so that they may be carried to long distances, but, on the other hand, they require special conditions for starting into life. They cannot withstand unfavourable surroundings so well as ordinary seeds can. Spores may be floating in the atmosphere everywhere, but nothing comes of them, as the conditions for germination and sustenance of life are wanting.

Later on, possibly, may have commenced the multiplication of plants by buds on their roots, and on underground stems, and finally by buds on the stems which rise into the air. The stem bud, or as it might be called, the bark bud, is probably the ancestral form of the seed bud, which we find in the fruit. From the bark, where it usually occupies the axilla of the leaf, or other representative of the leaf, we may trace it to the edge of the leaf,* in the angles (abortive axillæ), formed by the crenations (abortive leaflets), as in the Bryophyllum calycinum. Hence we can finally follow the bud to the edges of the curled up carpel, or modification of the leaf, such as the pea pod, or the pulp quarters of an orange or lemon—in what we call the *seed.*

The ripe seed of the fruit is then the finished article, furnished with an independent bud. It has moreover, as I said, a small store of food to sustain it, while it is perfecting its organs of nutrition—the roots and the leaves. The whole is furnished with coverings, which usually very efficiently protect the emancipated bud, and its store of food. The efficiency of the seed

* The leaf, as I have stated in another place, I would consider a *modified branch.*

coverings is certainly no mean advantage in the struggle for existence in certain plants.

As the seed germ is often stimulated into vitality by *foreign* pollen, the mature seed becomes a most important instrument in bringing about breaks, or distinct varieties. The seed is then a portion of its own mother plant, with frequently something superadded from another plant by means of foreign pollen. The seed of some plants are so well suited to struggling into existence, and competing with others, that they are enabled to float from one shore of an ocean to another. When stranded, they germinate in due course, and commence a new colony—such as the cocoanut. All the fruits of the large citrus float well, and the larger the fruit, and the thicker its skin, the better it will float. I believe it probable that many forms of citrus have become disseminated by the fruit floating down rivers during floods; stranding on their banks and islands beyond the river mouths, and liberating their seeds by the decay of the fruit. The seeds then germinate, and eventually found new colonies.

The seeds of some plants can lie dormant for many years, and when the proper conditions come, they start into life, and begin new colonies, where perhaps their species had never been before. I do not know how long citrus seeds can remain viable, after having been taken out of the fruit. In the ground, in winter, they remain viable for months. Irrespective of inheritance, there is something which we do not sufficiently understand. I mean the "jumps" or breaks, which occur through the seed. For instance, two distinct plants of the same species are crossed, and the resulting seeds sown. Some of the plants will be more like the male parent; some like the female parent; others will partake of both; and perhaps a few, or only *one* out of

the whole lot will be so different from both parents, as to form the commencement of a *new race*. What gives rise to these "breaks," as horticulturists call them, is not sufficiently understood. Now as breaks do occur, when plants are artificially crossed, so would they, I think, be liable to occur, when naturally crossed, either by insects or other ways. I have no means of knowing just now whether seeds from the same plant, *without* crossing give these decided breaks. The break or new form can be, it would appear, of three kinds—either a *reversion* to some ancestral form, of which we may know nothing; or it may be an entirely *new* form; or a *combination of both*. All breaks cannot be reversions. Supposing all the forms we see now have been brought about by a series of breaks instead of by gradual inheritance of accumulated variations, we must arrive at a time when there was little or nothing to revert to.

It is not improbable that, besides natural selection by a gradual step by step process, natural breaks may have played an important part in producing the infinite forms we see in nature. Of course a break may be either much more delicate or much more robust than either of its parents. In the first case, it would not last long, unless it could occupy places untenanted by other *more suitable* kinds. In the second case, it would probably extinguish, and take the place of its parents. Risso mentions several kinds of citrus raised from seed in the South of Europe, which were hardier than their parents, and which could therefore be pushed further north without being injured by frost, and the C. trifoliata is stated to withstand a cold climate better than any other kind.

There are so many varieties of cultivated citrus in India, China, and the Malay archipelago, that it is not improbable some may be descendants of the wild

species known at present. Some may have been produced by crossing, and by breaks, and others may be descendants of some wild *extinct* species. There is no reason why some of the original citrus, from which our forms may be direct descendants, should continue to exist any more than the Dodo, and other extinct animals. It is hardly reasonable, therefore, when we find some variety of citrus which is somewhat different from others, such as the pummelo, for us to expect that this must have some *wild species* in existence, from which it has directly descended, and although we have not discovered it yet, further search may probably bring it forth.

The birth-place of the genus citrus must have been originally rather circumscribed, because it is not a plant that can stand a very low temperature without perishing. Of course now it is found all over the world, wherever the temperature permits it to exist. But all this dissemination has been largely done by the hand of man, and within historic times.

Indian forest officers say that the most destructive agents to trees are forest fires, and these are often produced intentionally by herdsmen, in order that the old grass and scrub may be burnt, and by their ashes the new grass nourished. If these forest fires cannot be prevented now, just fancy what amount of forest firing must have taken place in times when man was still in a nomadic stage, and principally living on the produce of his cattle, wandering from place to place with his herds, firing here and there, never caring how many timber trees he destroyed, and how many species he extinguished, as long as he got new grass for his cattle. Besides fires in the nomadic stage, later on, during the agricultural stage, invasions must have occurred, and the total disappear-

ance of cultivated places, with their primitive huts and inhabitants.* Who can tell how often a tract of country has had its forest cleared, either by fire or other means, for purposes of cultivation and villaging, and then become reforested by new forms, to be at some future time recleared and reforested. It is evident that, in addition to natural causes, man may have had a hand in extinguishing many species. I see no good reason for insisting on there being a wild form of the pummelo somewhere, especially as the existence of the cultivated present large forms can, I think, be accounted for without much difficulty, by fusion of two ovaries, as in plates 223 and 224. See also plate 83, fig. *b.*

When we say that the carpels forming the fruit, and the floral apparatus, are modifications of leaves, we do not mean of the *present* leaves, but of some former expansion of the bark, which eventually was modified into the present leaves, the present flowers, and the present fruit. For all we know to the contrary, the original expansion of the bark in the citrus may have been of the nature of the modern green rind of the fruit.

In the *changura* or digitate citrons and lemons, we probably have a glimpse of how the citrus fruit began to evolve. In the "limonier digité" of Risso, fig. *a*, pl. 178, we appear to have, as I said, a *single* whorl of carpels, united at their base, and free at the distal ends, *without any inner whorl of pulp carpels.* The whole fruit is *rind.* In the digitate citrons of India, fig. *a*, pls. 139 and 140, we have a further step —a *double* fruit, with an outer whorl of rind carpels, and an inner one, *also* of rind carpels. The double digitate citrus is a step in advance of the single one,

* It is enough to read the history of Babylon and Assyria to realize what can be effected by this means.

but still a very primitive citron. This stage of fruit evolution having been gained, it is not perhaps difficult to pursue the investigation to its possible completion, according to my views. The inner whorl of rind carpels would naturally contain a hollow space, as in these digitate citrons (see *c* (A), pl. 139). The oil-cells of the outer whorl could not project beyond the rind of the inner whorl; but those of the latter could be prolonged and projected into the hollow interior. This circumstance, I take it, was favourable for the development of the elongated juice vesicles from the short oil-cells of the inner whorl, that is for their becoming larger and more differentiated. The oil-cells of the outer whorl, in the perfect orange, are often large, orange coloured, and project inwards like balloons (see pl. 122, fig. *k*). There is no trace of the regular *oil* cells in the *pulp* carpels of the perfect citrus, and therefore, supposing the latter to be the real carpels, the lobes or vesicles, which project inwards from them, as I have said, can logically hardly be others than transformed oil-cells. If we could forget the term *essential oil-cell* of the rind and leaf, and replace it by pulp-vesicle-germ, we might perhaps have little difficulty in believing all three to be *homologues*. In order to complete the history of the citrus fruit, according to my views, I have something further to suggest.

I believe that before the orange or lemon could have been perfected, as we see it in our orchards, the inner whorl of rind carpels must have developed some sort of buds in the axillæ of their crenations (or what would correspond to them), which, in course of ages, through the strictest selection, were perfected into the present citrus-seed. Otherwise it is difficult to conceive how variations of sufficient importance to cause

further decided progress could have occurred without the intervention of the seed-buds. By their help, and with the already enlarged oil-cells of the inner whorl, we can take another step. It is easy to imagine that breaks occurred, in which the enlarged oil-cells contained first a mixture of bitter and sour juice, and subsequently by further selection a sour and sweet juice, or an acidless secretion.

Figs. *d* and *e*, pl. 140, show us how a further step may have occurred. The free and digitate ends of the carpels finally curved inwards, like closed fingers, and by their cohesion, completed the outer casing of the citrus. Then, after becoming further improved, human selection for the sake of the pulp, completed the perfect modern orange and lemon. Risso, in his "fruits cornus et corniculés," gives us some idea of how many experiments nature may have made, through the means of the seed, before she succeeded in giving us a break with the beautiful and perfect cricket-ball orange we now possess.

There must have been a stage in the descent of the citrus, in which birds—probably parrots—have played a prominent part. The colours of the lemon and orange I take to be nothing but those of decaying or ripening leaves. In many decaying leaves of trees, first yellow and then orange hues come out, and it is not impossible that the yellow-coloured citrus was anterior to the orange-coloured variety. Even the orange is first yellow, and then orange. Anyhow, both are *green* like the foliage, before they take on their special colours. What the brilliant crimson Hibiscus, against its green foliage, or any similar brilliant flower, is to the insect, the brilliant yellow and red fruit is to the bird, nothing less than an advertisement, and an invitation to come and taste.

Now supposing a large variety, in all grades of development, of citrus fruit undergoing changes from seed by breaks, the bird might cut open one and be disappointed perhaps in finding nothing in it. It would break open the fruit of another tree, and so on, in search of something to carry to its hungry young in the nest. If by accident it came across a tree which was a break in the direction of some sweet, or even sour pulp, having seeds at the same time, it would carry the pulp to its young, and return again and again to that same tree. It would thus help to disseminate the seed of this improved variety, exactly as a horticulturist now does.* The seed is bitter and not nice to eat, and parrots in cages are often seen sifting the seeds of fruits with their beak and dropping them. Thus the seeds of the better and sweeter varieties would have a great advantage, by wide dissemination, and many chances of being dropped in rich suitable soils for further variation. Many varieties of citrus live very long ; and we have been told that in South America it is proof against drought and locusts. We also know it to be prolific. Therefore any good and palatable variety, having become known to all the parrots of the neighbourhood, would be visited, year after year, and infinite chances would be given it for the seeds to repeat other and better breaks.

In its seed the citrus fruit contains a very favourable condition for future progress ; and therefore it is important that the fruit should not be advertised, by changing its green colour, until the seed was perfect and sufficiently ripe for dissemination.

Further, the Citrus seed has two or more germs

* The selection of the sweet varieties, which *may* have turned up from seeds of sour ones, was probably done mainly by man.

or buds—that is, out of *one* seed two or more plants germinate. This is well known, and is an interesting fact, because in all the Citrus trees I have examined I found that in the axillæ of the leaves there are always two or more buds, and therefore the seed buds appear to be merely a repetition of the buds in the normal axillæ. Of a pair of buds, either one developes into a spine and the other remains dormant, or one developes into the usual branch, with a dormant bud at its base, or both remain dormant, or both develop into twin branches, or both the spine and the branch are developed side by side in the axilla of the leaf.

In the Malta orange tree spines are not easily developed, and often I have seen two branches in its axillæ. I have seen this also in the lemon. In the lime, one spine and one branch are almost always developed, side by side. I have also seen two branches and one spine in the same axilla of the lime. In the interesting Citrus australis, a seedling of which was kindly sent to me from the Botanic Garden of Saharunpore, there was the same peculiarity—a spine and a branch, or two spines, in each axilla. The multiple buds in the Citrus *seed* are therefore accounted for by the multiple buds in the axilla of the leaves, the one set being homologues of the other.

There are few trees, perhaps, which have perfected so many curious apparata as the Citrus to enable them to struggle efficiently with competitors and surrounding enemies, and to obtain allies in helping it on. It has provided itself with spines, sometimes so formidable that, as Mr. Webster says, even "an elephant refused to face the lemon-thicket." (*Vide* description of pl. 200.) Its fruit has taken on brilliant colours to attract passing birds, and has provided them with a palatable pulp, so that they may not fail to come again

and help it to scatter its seeds to great distances. It may have done more. Elsewhere I have stated that the oil cells of the leaves of young Citrus seedlings were possibly a disadvantage to them. I have seen pots full of seedlings devoured by the young caterpillars of the Papilio Erythronius, a butterfly that feeds exclusively on the Citrus leaves. The essential oil glands, however, are, I believe, an advantage to the adult tree in a wild state. The aura of the "petit grain" enables the butterfly to find any Citrus tree readily among other trees, where it may deposit its eggs to be nursed, when hatched, by the Citrus leaves, and eventually, in their butterfly stage, to help it to fertilize its ovary, and thus ensure a crop of seed. The delicious scent of its white flowers, which is more powerful at night, may be only another advertisement for night insects to come and help it in the same direction. It would therefore appear that this interesting tree, in the days of battling with its surroundings of all kinds, became provided with armour against the larger animals; a strong scent, which is unpalatable to destructive locusts, but agreeable to other insects which help in fertilization; and brilliant and palatable fruit, attractive both to the eye and palate of birds and other animals. Finally, when the Citrus came under the notice of man, its rapid and further progress to its present finished state was ensured. He may now go on and develop any part of the tree which may suit his purpose—such as the essential oil of the leaves, that of flowers or rind; the thickness of its skin, and the abundance and sweetness of its pulp.

In certain stages of its past history, instead of the attractive essential oil of the C. limonum vulgaris, there may have been formed a repellent secretion. In the *lima* of Ceylon (C. hystrix), I found that the rind

of the fruit had a resinous, acrid, and uninviting taste. In certain stages the fruit may have been nothing more than a protected receptacle or womb for the safe development of the seed—the part intended by nature to carry on the life of the species. The juice vesicles, as we see them now, may not have been developed till long after.

It is not improbable that the wild original man may have largely helped in the development of the thick skin of the citrons proper. In Mangalore, where they have large varieties, I was told that the outer bitter rind was shaved off by means of a knife, and the thick white and sweetish skin eaten raw. The thick skins of other large Citrus are also eaten elsewhere. It is probable, therefore, that these large citrons, with little or no pulp juice, may have been selected for generations for the sake of their sweet edible skin alone. Natives of India are very fond of eating carrots, large radishes, and cucumbers in their raw state, and the thick sweet citron skin is probably nicer than any of the above. The wartiness of certain citrons is probably the effect of rich soil and abundant moisture, producing an excess of skin growth. Generally speaking, the thicker the skin the less juice the pulp has. The pummelo has often a thick bitter skin, and plenty of pulp, but it is not noted for abundance of juice. On the contrary, the vesicles are coarse and often concrete and juiceless. The most juicy pummelo I have seen is the *thin-skinned* red pummelo of Bombay. That the original wild Citrus fruits may have had a thick warty skin may be probable, for we often see wartiness cropping up in cultivated varieties, possibly as a reversion to ancestral characters—such as certain varieties of the Séville orange; the Aurungabad orange (pl. 125, fig. *a*); the *mussembi* of Poona (pl.

44, fig. *f*); and the still more striking *Dumrêz* form of the "Khatta" (pl. 27, fig. *b*).

There is a point upon which I have not yet hazarded any speculation: that is—How could the oil cells of the Citrus first have come into existence? Were they oil cells from the beginning of time, or were they transformations of something else? Taking into consideration that these oil cells now exist all over the bark; that the axillæ, or angles, of the leaf crenations contain each an essential oil cell; that in the Bryophyllum calycinum buds are produced in similar positions, and that in homologous points of the pulp carpels seed-buds are developed, the suspicion might be raised in one's mind that after all these oil cells—so constant in all parts of the Citrus—may not impossibly be connected with "spore" sacks, or similar organs, in some ancestral cryptogamic form.*

The same powers which were equal to changing the five-toed animal into our one-toed horse, the lizard into the bird of to-day, the lower animal into man, would, I fancy, be also equal to bring about the changes I have tentatively endeavoured to sketch in the foregoing pages.

In discussing the possible morphology of the citrus fruit, a few words on its leaf may not be out of place. The leaf is an expansion of the bark, specialised for certain ends. It consists of two parts, the petiole (or leaf stalk), and the leaflet (or blade). These are united by a joint, like those of compound leaves, suggesting the idea that the ordinary citrus leaf was at some time a compound leaf. In fact, in the Citrus trifoliata, pl. 254, fig. *g*, we have a compound trifoliate leaf. In the allied genus, Œgle marmelos, pl. 242, fig. *f*, we have

* *Vide* note at the end of this chapter.

also a trifoliate leaf. In the Feronia elephantum and Limonia acidissima, we see still more compound leaves; *vide* pl. 244, figs. *b* and *c*, and pl. 245, figs. *a*, *b*, and *c*.

Moreover, in more than one instance in seedling citrus which I grew, trifoliate leaves were developed among the secondary leaves; *vide* pl. 246, figs. *d*, *e*, *f* and *g*.

The leaf stalk of the citrus varies from a wingless short petiole, like that of the Malta lemon (fig. *a*, pl. 181), to the enormous wings of the C. hystrix (fig. *d*, pl. 225). In many cases, the winged petiole of the latter is larger than the blade of the leaflet, such as is shewn in the same figure.

The leaflets of the citrus are emarginate. Even if the general shape be acuminate, they usually have an emarginate point, a mere indentation at the tip. Not impossibly this indentation has a meaning.

Had the remote ancestors of the citrus simple or compound leaves? In the embryology of the vertebrata it has been found that, up to a certain point, the embryos so resemble each other that they are practically indistinguishable. Afterwards they become differentiated, and each species progresses in its own way.

The embryology of the citrus leaves can possibly be studied in the primary and secondary leaves of its seedlings after germination, and also, perhaps, in the first leaves of each branch. They are different from the typical leaves of the adult tree.

The cotyledons of the citrus in germination remain under ground. In all, the first pair of leaves that show themselves above the ground are opposite and have no sign of joint between the petiole and the blade, and no sign either of margins or wings on the petiole. In many citrus, the first three or four leaves are also

without joints, especially in the *turunj*, *bajoura*, and lemons. Afterwards begins to appear the margined or winged petiole, and also the joint between this and the leaflet. In others, the joint is quite visible as a pale dot, but the margins of the leaflet are continuous with the wings of the petiole. Finally, the typical form of the leaves, whatever they may be, begins to be developed. If the variety has typically a *large* cordate petiole, at first this is small, and becomes larger and larger as the foliage of the seedling developes, until it assumes its typical adult proportions, which in the C. hystrix often exceed those of the leaflet. Of course, on any adult tree will be found a variety of leaves, owing to new branches being continually developed, and these frequently repeat in their first leaves embryonic forms, or, possibly, reversions.

In the *nepalee nimboo*, many leaves of the seedling have no joint, the leaflet edges coming down low on the petiole without any sign of joint between the two.

The *qeem* citron of Saharunpore has typically large cordate petioles, but the first four or five leaves of the seedling had no sign of joint. Then came one or two leaves with a joint, but with the margins of the leaflet and petiole continuous. Afterwards the typical form of leaf began to appear.

The Muscat large sweet lemon has first no joints, then joints with the petiole margin and those of the leaflet continuous. Sometimes indentations occur on the continuous edges on a level with the joints.

As a rule, those citrus which have normally large winged petioles show this expansion earlier, while the Malta lemon, the *bajoura*, and the citron and others go on for some time without showing any development either of a joint or separate petiole wings.

The *lima* of Ceylon, or C. hystrix, has its first *two* opposite leaves without joints, but the third leaf at once shows the joint and margined petiole, the latter becoming larger and larger as new leaves develop; see pls. from 246 to 255.

There is, I think, some reason to suppose that the original leaf of the citrus was a *simple* leaf. This idea is strengthened by the enormous winged petiole of the C. hystrix, and also by the typical emargination of the distal end of the leaflets in all citrus, whether acuminate or not. This indentation would appear to be the position of another, though abortive, leaf expansion or bud.* So that not impossibly the original leaf of the citrus was only the winged *petiole* of to-day. Then by another expansion or leaf bud from the petiole emargination at the tip the leaflet originated, and by side buds the trifoliate leaf was formed. One might, perhaps, familiarise himself with this view by considering how the branches of the Epiphyllum, one of the cactaceæ, are formed. Fig. *f*, pl. 245, gives a diagram of it. The fully developed leaf of the C. hystrix, pl. 225, figs. *d* and *e*, would appear only a modification of something like an Epiphyllum branch. Then, if by proliferation from the joint, which may be considered as a *node*, a pair of additional bark expansions occurred, we would get diagram fig. *g*, pl. 245, which would resemble a part of the leaf of the Limonia, Feronia, and others. In the leaf of the Limonia, pl. 245, *a*, *b* and *c*, there would appear to be a tendency to this mode of proliferation, carried on almost to any extent.† In such case, the original trifoliate leaf of the citrus would have

* Such as may have occurred in the leaf of the Limonia referred to.

† The simple leaf being an expansion of the bark, the compound leaf might, perhaps, be considered as a *branch-form* expansion of the same.

been one leaflet expansion from the tip of the *original* simple leaf (now the winged petiole) and two opposite leaflet buds from the same node forming the leaf of the C. trifoliata. Eventually, the middle leaflet, absorbing to itself most of the nourishment, grew more than the side ones, and finally extinguished them, and in many cases dwarfed the petiole leaf. These side leaflets, however, in the seedlings now and again reappear among the first or embryonic leaves.

In the citrons proper, and *bajouras*, leaves like those of pl. 247, fig. *a*, and pl. 250, figs. *a* and *b*, and others, are very common, even in adult trees. They have no sign of joint, and one not knowing the compound nature of the citrus leaf, would take them for *simple* leaves. Whether these are reversions to the supposed ancestral simple leaf, or cases in which the joint has been extinguished, and the edges of the leaflet and petiole wings become continuous, it is impossible to say.

In the *Gardeners' Chronicle* of 5th Nov. 1887, page 560, the figure of an abnormal Begonia is given. The ovary, instead of being wholly inferior, as is usual, is partly superior, with the base of the carpels open, showing numerous ovules. This is not all. Between and within the carpels, is a tuft of perfectly formed stamens. "A more topsy-turvy violation of morphological sequence can hardly be met with. . . . Here we have a flower, that is usually unisexual, becoming structurally bisexual. We have carpels which are generally closed, so as to conceal their contents, gaping apart, to disclose the ovules; while in the very centre of the flower, within and between the divergent carpels, are the stamens, some of which stamens, as it appeared to us, occupied the place of ovules, and were indeed substitutes for them."

In Asa Gray's "Structural Botany," page 171, is given a monstrous flower of white clover, after Turpin, in which "the pistil is stalked, and the ovary open, and the margins bearing leaves instead of ovules."

As the plumule of the seed, which is the developed ovule, is homologous to a branch, and as this branch, according to the monstrous clover, can be transformed into a leaf, it is reasonable to infer that the normal leaf is probably nothing but a *transformed branch, arrested in its growth and turned to other purposes.* The leaf-like branch of Ruscus androgynus would perhaps give a better idea of what I mean by comparing the leaf of the citrus to a modified branch.

The abnormal Begonia alluded to, shows the same transformation, viz., of ovules changed into stamens, which in their turn are modified leaves, and are often changed into petals or leaves.

According to this mode of reasoning therefore, the leaf of the citrus, would be a modified branch, the serrations on its edges, abortive leaflets, the oil cells in their angles, abortive buds, in abortive axillæ; and to conclude, the normal bud, the spine, the oil cell of the leaf and the rind, the juice vesicles of the pulp, the pollen grains, and the seed-bud would all have to be considered as *homologous.*

It is true the leaf is often deciduous, while the branch is not, but the flower and the fruit, which are admitted to be modified *branches*, are also mostly deciduous, when their function on the tree has been completed. Moreover, the leaf, or as I take it, the modified branch, after it has completed its special function, is more serviceable to the tree off than on. The old persistent leaves, besides absorbing some of

the limited nourishment of the tree, might injuriously shade other leaves from the sun, while the deciduous leaves, after decaying, would furnish manure or raw materials for further growth.

In connection with the trifoliate leaf of the citrus, I would refer to Dr. Masters, fig. 32, page 74, of his "Teratology." He gives it as a curious instance of an anomalous form of orange. I have reproduced it in pl. 241, fig. *d*. In this figure, I have endeavoured to complete by the dotted outline *d'*, this tricarpellar orange, as I think it possible to have been. It would appear that each leaflet, or carpel, instead of uniting with its fellows, to form a round or oblong fruit, had formed a separate orange, consisting of *one* carpel, like that of a pea-pod, viz., that of the odd leaflet, and one of the side ones, the third leaflet-carpel remaining undeveloped. Dr. Masters does not give any details of this anomaly, so that I cannot say whether this might be the probable view. Risso gives several examples of "horned" oranges, in which one or more of the carpels remained separate, each having within its rind-carpel, a separate pulp-carpel.

All this chapter is nothing but a speculation, and the reader may take it for what it is worth. Sometimes speculations have this value. Although absurd in themselves, they may tempt some one to make observations and experiments in directions which possibly he might not think of. Evolution of thought, like all other evolution, can take place only by slow degrees, and if what I said will help, in any way, future investigators in this obscure region, this chapter may perhaps not be wholly useless.

It is not easy to convey to the reader a clear notion of what a large part of this chapter is about. One requires to have pondered over the subject, and to

have passed several years in examining citrus fruit and leaves of numerous varieties, and at all stages, not to come to the conclusion that all I said justifies the quotation given at the head of this chapter. This frequent pondering of course may have the disadvantage of producing what the French call *idées fixes!*

NOTE.—The "Physiology of Plants," by Jul. Von Sachs, p. 183, gives the following: "The internal glands in the skin of the fruit of the orange are very conspicuous and large; they abound in ethereal oils, and appear in transverse and longitudinal section, as roundish cavities, from which the inflammable ethereal oil spurts out, on the application of pressure. Such glands originate, so far as investigation extends, from a single mother cell, which, as it slowly develops, undergoes many divisions in all directions, so that a multicellular mass of tissue of roundish form arises, the cells of which subsequently become remarkable as containing very granular, apparently dead protoplasm. Later on, the thin cell-walls dissolve; the process commencing in the middle of the spheroidal group and proceeding outwards. There thus arises a roundish cavity filled partly with watery sap, partly with drops of ethereal oil or balsam—the products of solution of the mass of cells. The layers of tissue surrounding this cavity fit closely on all sides, without intercellular spaces, and thus form a kind of wall to the receptacle for the secretion (well seen in the leaves of the Citrus)."

Is there much in this genesis of the oil-cell, which differs from that of an *ovule*, whether vegetable or animal?—E. B.

CHAPTER XV.

DISCUSSION ON THE ORIGIN OF THE DIFFERENT VARIETIES OF CITRUS, AND ON THE DERIVATION OF THEIR NAMES.

THE object of discussing the derivation of the numerous names of the citrus family is, if possible, to obtain some clue, through the name, of the *origin* of that particular variety. I shall take them as far as I can, in the order of their chapters.

The Orange.—We have *nàrunj*, *nàrang*, and *narànghi*, from which probably the European names have been derived. I have not been able to make out satisfactorily that this name is indigenous in India. But to leave no stone unturned, I referred the question to various orientalists. Their courteous replies are given in the course of this chapter.

Mr. Growse, of the Bengal Civil Service, states that no genuine Sanskrit work makes any mention of any kind of citrus. The Pundits of Benares, however, say that there is a book on medicine, called *Mandanpâl nighùnt*, dated 1411, *Sùmbut* (about 531 years ago), which mentions both the sweet and the sour orange, under the name of *naranghi*, as follows:—(*a.*) Is sour-sweet. It increases the appetite, and counteracts flatulence. (*b.*) Is sour. It is extremely heating and difficult to digest. It is laxative, and also counteracts flatulence.

The Pundits also say that the derivation of the word is from *nag-rang*, the colour of *sendùr*, or red lead.

Sir Monier Williams states that *naranga*, an orange, occurs in a Sanskrit work on medicine, called *Susrata*, and that it *may* be a corruption of *naga-ranga*, having the colour of *nàga*, which certainly has a meaning "lead." But he is inclined to think that *nàranga* is a foreign word, and comes from the Persian *nàranj*.

Professor E. B. Cowell, of Cambridge, states that the word *nàgaranga* is found in the *amarakosha*, the oldest Sanskrit dictionary, perhaps of the 8th or 9th century A.D.* The contracted form *nàranga* occurs in the commentary to the old "Unâdi sutras," which was written about 1300 A.D.

We are here at once met by the difficulty of not knowing to what type of orange these old works refer—whether to the Séville sour orange; the Portugal sweet orange; or to the *sùntara* sweet orange, or the sour varieties of the latter type.

Professor A. Vambèry thinks that *nàrang* is decidedly taken from the Persian *nàrandj*, which is composed of *nàr*, pomegranate, and *randj* (properly *rang*) colour.

There appears to be no doubt that the Séville orange was the first orange to get to Europe. This has some significance—that is, wherever it was taken from, there could not have been at that time sweet kinds of any sort commonly known; otherwise they would probably have been taken also to Europe, at the same time.

Moreover, in Baber's Memoirs, Humayoon writes that in his time—about 300 years ago—the *sàmterah*

* According to M. Reinaud it appears that the *Amara-cocha* was written in the 5th century.

(*sùntara*) orange was known only in one place in Bengal.*

Colonel Yule, in his "Glossary," has the following: —Abulfeda says—A.D. c. 930, "the same may be said of the orange tree (*Shajr-ul-nàranj*), and of the round citron, which were brought from India, after the year (A.H.) 300, and first sown in 'Oman.' Thence they were transplanted to Basra, to Irák, and to Syria. . . . but they lost the sweet and penetrating odor, and beauty that they had in India, having no longer the benefits of the climate, soil, and water peculiar to that country."—Mas'udi II., 438–9.

By "sweet and penetrating odor" Abulfeda probably refers to the very aromatic rind of the Séville orange.

In South India (Tanjore) they have an orange called *nàrtun.* This I found is no other than the Séville orange. Colonel Yule in his Glossary, p. 490, has the following:—"In Tamul dictionaries most words beginning with *nar* have some relation to *fragrance;* as *narukeradu,* to yield odor; *nartum pillei,* lemon-grass; *nartei,* citron; *narta manum* (read *marum*), the wild orange tree, &c." I think, therefore, one would not be far wrong in concluding that the Séville orange in South India was either indigenous or had been naturalized there from prehistoric times. It is worth mentioning that at Mangalore, on the Western Coast, I found the Séville orange called *karna,* which Mr. Growse informs me means *bitter.* Neither at Tanjore nor at Mangalore had this orange the name of *nàrang* or *nàranj.*

Rumphius, in chap. 41, vol. ii., describes the Séville orange under the name of *Aurantium acidum.* It does not, however, appear to have been very common in the

* The *sengtereh* of Baber's own memoirs appears to be a different thing.

Malay archipelago in his days. He says, "It does not occur in all the islands of maritime India. Moreover in Java, Baleya, and Celebes, this orange is unknown. In Amboyna it is more plentiful, but in Ternaté and Banda they are rarely met with. It was mainly used for cleaning copper ware, and for washing the head. The wood was used for handles of implements, and the fruit was sometimes used as an ingredient in a sort of rustic *punch*."

Unless allowed to run wild, there was no good reason for the Séville orange becoming common in the Malay archipelago. It was not good to eat, and its strong seedlings were not used as stock because the art of budding or grafting was not known there in the time of Rumphius. Moreover they had the Portugal sweet orange, and also the *sùntara* orange, the *kaghzi nimboo*, and a variety of citrons and lemons; nevertheless the Séville orange was there, and rather plentiful in Amboyna.

Loureiro, in his "Flora of Cochin China," gives *citrus fusca* as similar to that of tab. 33,—*Aurantium acidum* of Rumphius—the Séville orange. He further says that it is very widely spread in Cochin China, and more rare in China.

I think we have come here near the birthplace of the Séville orange, but the whole argument of course rests only on a strong probability.

The following is probably the course the Séville orange took:—It commenced in China or Cochin China, and found its way to the Malay archipelago. In the time of Rumphius there was a great number of Chinese residing in those islands. From the archipelago, at some very distant time, it found its way to South India by means of traders, where it became naturalised, and got the name of *nàrtun* on account of

its fragrant flowers, rind, and leaves. Eventually the Arab or other traders took it thence to Persia, where, as Professor A. Vambèry thinks, it may have got the name *nàrandj*, "like a pomegranate." But as it may have had already the first part of its name *nar* in Tamul, in connection with its fragrance, it is more likely that this part of its name went to Persia from South India *with it.* Then the *ranj* or *rang* may have been tacked on afterwards. From Persia it got to Syria, Africa, and Spain, under its Arabic or Persian name *nàranj*, and probably also back to Northern India, under the name of *nàrang.* Such a theory would appear to fit in with the facts known.

The *Khattà Orange.*—I call this orange, because it has an orange exterior, an orange pulp, and orange-like leaves. It is, however, rather prominently mammillate, and its flowers externally are tinged red. Natives almost universally call it simply *khattà*, which means *sour.* Some call it *karna*, confounding it with the Séville, and others call it *gulgul*, confounding it with a large sour lemon. Very little use is made of it, beyond sowing its seeds for raising stock to bud other kinds on. They say the seed germinates better when the fruit is yet green. It is almost the only kind used for this purpose. No book that I have seen mentions it, and nothing appears to be known of its origin.

The *Portugal or Malta Orange.*—In only one place, in South India, have I found this variety with a native name. In Tanjore they have a large fine variety of this type called *bàndir*, but Dr. Shortt says it is also called *cheenee.* It is figured in pl. 43, fig. *a.* I have not been able to trace the derivation of the name *bàndir.* This type of orange is to be found in many other places in India, and also in Ceylon, but everywhere, for want of a native name, it appears to be of

comparatively recent introduction. In Ceylon, it is either called *aranj* or *peni-dòdan*, which is said to mean simply a sweet round orange. There, sour oranges are called *amool-dòdan*. In Poona they have a variety called *mussèmbi*, which is evidently a corruption of Mozambique. In Bombay they import a nice variety of Portugal orange from Zanzibar, which they call either *mussèmbi* or Malta orange. In the Bombay market, the one they import from Poona they distinguish by the name of *Poona mussèmbi*. In Tanjore they have a second variety, which the English there call Spanish orange. In the Upper Provinces it is known by the name of Malta orange or *Sylhet*. The orange from the latter place is of a totally different type, and is the one which goes to Calcutta under the name of *kàmla lemboo*. The Portugal or Malta type of orange I know has been recently introduced in four or five different places—viz.: Ceylon, probably with the collection from Egypt; in Lucknow, Jaunpore, Gujranwàla, and probably also in Lahore, with the collection from Palermo mentioned in Colonel Yule's "Glossary." The best of all is the blood orange of Gujranwàla. It should be noted here that Rumphius in chap. 43, vol. ii., describes what I take to be a Portugal orange, under the name of *Aur. verrucosum*. In Amboina it was called *Lemon Tsjina*, and mostly cultivated by the Chinese inhabitants. It was then considered a recent introduction in the archipelago. He further says that in China there are two kinds of it, one common, which is there called *Bit-cam*, that is, *Limo regius;* and the other *seng-cam*.* The latter is double the size of the common kind.†

* Here we may possibly have not only the first part of *kamala*, but also the first part of *sengtereh;* vide derivation of *sùntara* further on.

† It would appear that the Portugal orange came from China, *via* the Malay archipelago.

The *Pummelo.*—In the Upper Provinces it is mainly known by two names—the *mahtàbi* and the *chakôtra*, while for South India, a large number of extraordinary names are given in Colonel Yule's "Glossary." The derivations of *mahtàbi* and *chakôtra* given by the Pundits of Benares are very instructive. They show how little reliance can be placed on any endeavour to get at the derivation of a word by its resemblance to some Sanskrit or other word. They say that *mahtàbi* comes from *mahtâb*, the moon, from the moon-like size of the pummelo; and that *chakôtra* comes from *châk*, a wheel, from the huge size of certain pummelos. In Bengal, however, the pummelo still retains a similarity to the name with which it came to Calcutta, viz.: *batàbi-lemboo*, and this is no other than the citrus of *Batavia*, whence it was first brought to Calcutta. The word *chakôtra* has an equally interesting derivation. It was Mr. Growse that first called my attention to p. 54 of Colonel Yule's "Glossary," under "Batavia." He says: "It is the famous capital of the Dutch possessions in the Indies, occupying the site of the old city *Jakàtra*, the seat of the Javanese kingdom." So that we have here both the new and the old names of the capital of Java, amply accounting for both *mahtàbi* and *chakôtra*, the pummelo, which is known to have been comparatively recently introduced into India from Java.

The names of the pummelo in South India, given in Colonel Yule's "Glossary," p. 546, are curious. However, I think they indicate an introduction there independently of that in Bengal. Colonel Yule states that he has not been able to trace their origin. It will be seen, however, that, with few exceptions, if the words are properly divided, they resolve themselves into corruptions of the Dutch name Pompel-moes. What the

origin of this Dutch name is, I do not know. Dividing the words as follows, I think their derivation becomes apparent :—

Poomli-mas,
Pumpali-mas,
Bambuli-mas,
Bombari-masa,
Pampara-panasa.

Then *Bambali-naringi* is merely dropping the *mas* of *Bambulimas,* and substituting the generic name *naringi.* Then *papannas, papanas,* or *papanis* may be a still further corruption of Pompel-moes, or of only the latter part of *Pamparapanasa.* They all probably indicate that the introduction of the pummelo into South India was owing to the Dutch.*

Not impossibly also some ancient savant of South India, who may have possessed a copy of Rumphius's "Flor. Amboin.," may have helped to give many of these names their present aspect by endeavouring to identify some of them with those given in Rumphius. Under chap. 37, vol. ii., *Limo agrestis* (*Lemon papeda*), he says: "Another variety of this species is called *Lemon carbou.* Externally it is yellow and its pulp is white and very acid, and of the size of a child's or man's head." He adds, that to all large things the Malays apply the name of bull or elephant, and at the end of the chapter Burmann says: "It may be also noted, that *Lemon papeda,* and *Lemon carbou,* is *Limo bubalinus*—a Valent. in Amboinæ descript., p. 189." So that not impossibly this *Limo bubalinus* may have given origin to some of the strange names of the

* It is curious to study the native corruptions of European names. Montmorency they turn into *Mackenziemore.*

pummelo in South India. But I think most of them are more likely to be corruptions of the Dutch *Pompelmoes.*

In Ceylon the pummelo is called *jambole.* Dr. Trimen states that this word is not Singhalese, and that another name for it is *rata-nàran,* meaning "foreign orange." Rumphius, in the chapter on the pummelo, says: "Some in Malay call it *jamboa,* from the Portuguese *samboa,* which properly denotes the Pomp-sires, or Pomum-adami of the Spaniards. It is not, therefore, improbable that both the name *jambole* and the tree itself were introduced into Ceylon by the Portuguese.

Many of the pummelo-like *amilbêds* of India may, for all we know, have been also introduced by seed, or otherwise, from the Malay archipelago. They are all sour; and Rumphius describes various kinds of citrus, which are lemon-yellow, large and sour. The name *amilbêd,* the Pundits say, comes from *amlavetasa, amla* meaning *sour,* and *vetasa*——(?).

The birthplace of the pummelo, like many other kinds of citrus, was probably Southern China or Cochin China. Loureiro, in his Flora of the latter place, says of the C. decumana that "There are many varieties which grow in forests." The pulp is either red or white, sweet or acid. Rumphius, in describing the pummelos of the Malay archipelago, says: "These trees, in these East Indian regions, are not common, and they are considered as having been at one time brought from higher regions," meaning probably *more northerly* regions. Alphonse de Candolle seems to think that its birthplace was the islands of the Pacific, under the supposition that the pummelo is a distinct species and should *somewhere* have its *wild form.*

I have discussed this point in the chapter on the *pummelos*, and have come to the conclusion that it is not a distinct species, but is possibly an offshoot of the *C. aurantium sinense*, Gall., or some similar orange, and not improbably it had its origin in Cochin China.

The word pummelo is, of course, a corruption of the Dutch Pompel-moes, through Pummelnose, by first making it Pummelos, and then turning it into the singular *Pummelo*. Shaddock is said to come from Captain Shaddock, who first introduced it into the West Indies.

Pl. 92 gives the figures of the "forbidden fruit" of the English shops. The fruiterer said they came from Palestine. I give them for comparison.

The Sùntara *and* Kàmala *Oranges.*

These oranges, as I have already said, although sweet, are totally different from the sweet Portugal oranges.

The Pundits of Benares have invented two different derivations for this word *sùntara*. (*a.*) *Sùntarati*, which is made up of *sun*, meaning *well*, and *taràti*, a thing that floats, the whole meaning *a thing which floats well.* Now the *sùntara* orange floats very well indeed, and in the rivers of the Khasia hills, whence these oranges are brought down in boatloads for the Calcutta market, this phenomenon must have been often seen, viz., a *sùntara* orange floating down the river. (*b.*) *Sùntùnrati*, which is made up of *sùntun*, meaning bottom, and *ràti*, a thing which clings to something else; the whole meaning a thing which is adherent in its bottom part. This would also apply to the *sùntara* orange. These pretty sounding derivations, however, are said to be *impossibilities* in

Sanskrit, both by Mr. Growse and Prof. Cowell of Cambridge.

Many insist that *sùntara* or *sùntra* is no other than *Cintra,* a town in Portugal, noted for oranges, and that the Portuguese introduced this type of orange into India from there, and that the *sùntra* orange is no other than the *orange of Cintra.* Of all explanations, this is the least likely, for the following reasons :—

(*a.*) The orange of *Cintra* is the Portugal orange (C. aurantium sinense, Gall.), with a close-fitting skin. Of this orange there are now many varieties in the English shops, viz., the oranges from Brazil, Florida, St. Michael's, Valencia, Dènia, Jaffa, Malta, and others of the same type. While the *Sùntara* orange is a totally different thing (A. sinense, Rumph.). I have seen none of this type in the English shops. It is loose-skinned, and the nearest approach to this type is the mandarin orange (called Tangerine in the English shops).

(*b.*) If the *sùntara* orange had been introduced into India by the Portuguese, it would be reasonable to expect that its cultivation would be now more extensive towards the *coasts* of India than in the *interior,* while it is just the opposite. On the slopes of the N.E. hills, from Kumaon to Khasia, the *sùntara* orange is semi-wild ; and, about 300 years ago, in the time of Humayoon, it had only reached one village of Bengal, *Senargam.* Humayoon calls it *samtereh,* and no doubt it is the same orange he wrote of.

Colonel Yule in his Glossary says that "Abulfeda as early as the beginning of the 14th century extolled the fruit of Cintra," although it is not quite certain that he meant the *orange.* Renaud's version says, "pommes admirables pour la grosseur et le gout."

The Glossary also says that Hehn supposed the sweet orange was first brought by the Portuguese into Europe from China in 1548.

Sir C. F. Bonham, Secretary to the British Legation, Lisbon, has very courteously obtained the following information for me. Writing from Cintra, 2nd Sept. 1886, he says:—

"I now forward to you all the information which Sir Francis Cook has been able to get from old books in his possession on the subject of oranges. He is a man of considerable knowledge of plants, and possesses a large estate in this neighbourhood. In the course of conversation on the subject, he has told me that the sweet orange, citrus aurantium of Portugal,* is undoubtedly of Chinese origin; that the date of its introduction into Portugal is somewhat uncertain; that he has much reason to believe it was introduced into Portugal by D. Joao de Castro, about the year 1480, and planted on the terraces of Ponha Verde (a place near here), where its descendants still exist.

In order that the *sùntara* orange of India should have become so widespread ón the N.E. border of the Peninsula, it is reasonable to suppose that either it must have been *indigenous* there, or introduced *long before* the dates given above of the introduction of the sweet orange into *Cintra.* The probability is that it was brought from China or Cochin China, across the N.E. border in *prehistoric times.*

I have left no stone unturned in order to get at the bottom of the origin of this *sùntara* orange, and possibly at the derivation of its name. It would be as well to mention all the known variations of this name. In the Khasia hills it is not clear that it is commonly known by this name. There, in Bengali, it

* C. aurantium, Gall.

is called *kàmala*, and in Khasi, *usoh niamtra.** In Nepâl it goes by the name *sùntola*, or *suntowrea;* in Kumaon by the name of *shôr*, and also by the name of the *Bagèshwar* orange, from the fair where it is largely sold, and also the *Gungoli hât* and *Ramgunga* orange, where it is largely grown.† In the plains, it is called by the educated people *sùntara*, and by others *suntra*, *sungtra*, and in Delhi also *rungtra*. The Europeans call the Delhi orange *Cintra orange*, and by the English in Calcutta it is known as the *Sylhet* orange.

I asked Mr. Stevenson, the Deputy Commissioner of Sylhet, whether the Khasis had any legend about this orange. He replied: "Nothing is known as to the time when orange cultivation began in these parts. From the extracts of the lives of the Lindsays, appended to Dr. Hunter's 'Statistical Account of Sylhet,' it would seem that there were oranges growing spontaneously in the mountains some time previous to the close of last century (1776). No one knows how the orange was introduced here. All agree that it is *not* indigenous, and the legend has it that Hanumàn, a general of Rama, introduced the plant on his return from Lanka (Ceylon). Some people say seeds were brought from Assam proper."

More recently Mr. Stevenson very kindly wrote again, and said: "I have been endeavouring to obtain some clue to the derivations of the Bengali-Khasia names of oranges of all kinds. Their origin cannot be at all had. I asked the chief Khasia official at Shillong, and he was quite in the dark. I then consulted the missionary of the Welsh Presbyterian Mission in the Khasia-Jaintia hills. I enclose Mr. Jerman Jones's

* Mr. Stevenson says *usoh santra* (*vide* Appendix, No. 43).

† Mr. H. Harris, of Sitowli, informs me that these are all *one*, and resemble the *Nagpore* orange.

reply. He is the oldest missionary in the hills, and very intimate with the language, the people, and their legends."

Mr. Jones writes as follows, dating from Shillong: "The right way of spelling the different names of oranges is this:—

	Bengali.	*Khasi.*
1.	*Kàmala* . . .	*Usoh niamtra.*
2.	*Naringi* . . .	„ *Sim.*
3.	*Moglai* . . .	„ *myngor.*
4.	*Satkara* . . .	„ *Kuid.*
5.	*Kaki* . . .	„ *niang-riang.*
6.	*Khaterjanni* . .	„ *Kymphor.*

"I have never found a Khasi who could offer the remotest suggestion as to the derivation or meaning of *niamtra*, though I have asked a great number of persons, and it is the same with regard to the word *sim.* The latter is the Khasi term for a *Raja.* The Khasis call the best sort of Bananas *kait sim.* It may be that the Khasis used to look upon this fruit as the best among the oranges. They have not any legend or tradition as to how or whence the oranges were introduced into this country. The invariable answer is, 'God put them in our country, and how can we know anything about them?'"

In *Blackwood's Magazine* for September, 1886, there is an interesting article by Major-General A. R. Mac Mahon on "Burmese border tribes and trade routes" (*vide* Appendix, No. 2). It states that a century before the Christian era the Emperor of the Han dynasty fitted out an expedition to find its way through S.-W. China to India, but his plan was frustrated by the Shans, who then occupied Yunnan. The Shans were eventually expelled from their country, and, gain-

ing strength, they invaded the Brahmapootra valley in the eighth century, and completely occupied it in the beginning of the thirteenth century. But from ancient Shan records, discovered by Pemberton at Manipur, it appears that in the beginning of the Christian era the Shan kingdom occupied the whole of the region from Yunnan to the S.E. boundary of the Assam valley. The article also mentions that the Shans are most ingenious cultivators, and that they equal the Belgians in the great care and ingenuity they exhibit in cultivating their land.

Now China, or Cochin China, is considered by most authors as the birthplace of oranges, and it is said the Chinese claim them as indigenous to their country. If so, we have an efficient cause for the naturalization of the *sùntara* orange on the N.E. border of India. This great migration of Shans, which commenced at the beginning of the Christian era, from Yunnan to the Brahmapootra valley, could hardly have helped carrying with it this and perhaps other kinds of oranges, by means of the seed; no other mode of propagation is known in the Khasia hills, even at this day, than by seed. More especially is this likely to have been the case when we are told that the Shans are such ingenious cultivators.

Again, in the Khasia hills the generic name for oranges is *usoh*. This very word, slightly modified, curiously enough occurs as the generic name of the Citrus in various islands of the Malay archipelago. Rumphius, in his "Flor. Amboin.," in the chapter on *Limo tuberosus*, says: "Generally, however, all lemons (Citrus) are called by the Amboinese *aussi* and *ussi*, and by the Chinese they are given the generic name of *cam*. In Banda the generic name is *usse*. And in chapter 42, vol. ii., he describes the Aurantium

sinense (*Lemon manis Tsjina*), evidently introduced from China. Both the picture and the description of this orange agree entirely with the *sùntara* orange of India,* and in the days of Rumphius this *sùntara* orange was found in almost all these Oriental islands, from Java, Celebes, and the Moluccas to Amboina." In the latter place this orange was called *massussu.*

We have here, I think, something tangible to go by. The community of the generic name *usoh*, *ussi*, or *usse*, to the Khasia hills and the Malay archipelago, would appear to indicate that it either came to both these places from a *common* source, or that one place got it from the other, probably by way of the Malay peninsula. In the Archipelago it was considered as a *Chinese* orange.

The only legend that Mr. Stevenson has been able to get hold of is, that this *sùntara* orange was brought by Hanumàn, a general of Rama. This story would, perhaps, fit in with the great invasion of Shans into the Brahmapootra valley.

As to the rest, I have only suggestions to make. If its introduction in the N.E. border of India was effected by the Shans, it may not be impossible that the first part of the name of this orange—*sun*—may have some connection with *Shan.* Then it appears that *sim*, besides being the Khasi name of an orange, also means *Raja*—the *Raja orange* (Usoh-sim). Not impossibly, also, this word *sim*, or modifications of it, may have entered into the formation of the word *sùntara* by way of *samtereh*, or *sintra.* In those parts, they have another variety called *usoh niamtra.* This may possibly have given origin to the name *rungtra*, which, in Delhi, is a synonym of *sùntra.* Rumphius, however, says that in China they had two kinds of

* *Vide* pl. 116 A.

Portugal orange (Aur. verrucosum), viz., the *bit-cam* and the *seng-cam.* Could the *seng* of the latter have had any connection with the *sung* of *sùngtara?*

We have, finally, the other synonym *kàmala*, or *kamla-lemboo.* It may not be impossible that *kam*, the Chinese generic name for oranges, may have entered into the construction of this word.* The *keonla* orange of the plains, or as some call it *kawnla*, is, however, not the *kàmala* of the Khasia hills. The latter is the *sùntara* (aur. sinense) of Rumphius. The *keonla* of the plains has a redder, and more chagrined exterior, usually mammillate, and it sweetens very late. Its typical leaf moreover is different, and has also a different scent. Both the *sùntara* and the *kawnla*, belong to the same group. Whether the *keonla* of the plains corresponds to any of the other citrus of the Khasia hills enumerated in Mr. Jerman Jones's letter, I do not know.

To recapitulate then, we find that the *sùntara* orange of India, is totally distinct from the orange of Cintra in Portugal, and cannot have been introduced under that name by the Portuguese; that it has been known on the slopes of the N.E. border from time immemorial, and must have been either indigenous there, or have been introduced across the Eastern border, in very ancient times, or from the Malay archipelago, by way of the Malay peninsula. Its birthplace, however, is more likely to have been either China or Cochin China. Loureiro in his Flor. Cochin-chin., does not describe any orange which coincides with the *sùntara* orange of India. But Mr. Gubboy, who resided in Hong-kong, informed me that there they have an orange, called *loose-jacket.* This

* Possibly, also, it may have got its name from the river Kamala, near which it is said to grow.

is probably no other than the *sùntara* orange, the Aur. sinense of Rumphius, who considered it introduced into the Malay archipelago from China.

We have also the *hazàra,* which I consider to be no other than the *kumquat,* allowed to grow into a bush. With cultivation, it produces larger fruit than the latter. Its name *hazàra* is probably derived from the thousands of oranges a large bush produces. The *kôkni* is another small and sweet orange of the *sùntara* type. In Saharunpore they also call it the China orange. Rumphius, in chap. 42, vol. ii. (Aur. sinense), says that the Chinese in their own country have very elegant round oranges, of the "second variety," which are smaller than the common kind. They preserve them whole in sugar. Not improbably, this small variety of the *sùntara* type mentioned by Rumphius may be the *kôkni* of India.

The *reshmi* orange is another variety of a similar type. Its name would appear to mean "silky," but I do not see how this would apply to the fruit. I have not been able to trace the origin of this variety. It is never met with in the markets, and does not appear a favourite kind for growing in large quantity.

The *Mandarin orange.*—This is of recent introduction in India. I have met with it nowhere, except where it was obtained from Lucknow. In the latter place it was imported in 1863. I found it also in the Peradeniya garden, in Ceylon. Here also, it appears to be of recent introduction, and probably came from Egypt, with a collection of orange trees in 1847. In the Ceylon markets, they have the *kònda nàrun,* and the *jàwa nàrun,* both of which they call mandarin oranges, but they are no other than varieties of the *sùntara* orange of India. The *kònda nàrun* is almos identical with the Nagpore orange.

In Sylhet, Mr. Stevenson thinks they have the mandarin orange. But if they had the real thing, it would have long ago attracted notice in Calcutta, whereas I have never heard of, or seen it there.

Sir C. F. Bonham, in his letter from Cintra, says that Sir Francis Cook further tells him, "That the Tangerine orange, so called, is evidently the mandarin orange, also from China,* and bears that name because it was a much more rare fruit, and only within the reach of mandarins and grandees." Not improbably however, it was given that name for the same reason that the Khasias give some fruits the distinctive name of *Raja* (sîm), as being the *best* of their kind.

The *Jhambìri.*—For this name, a Sanskrit origin is claimed. The Pundits of Benares say it is mentioned in the *madun pâl nighùnt*, a book on medicine, about 531 years old. Therein is stated that the *jhambirikà* (meaning the small *jhambìri*) "puts the teeth on edge (*dantân shăthăti*), but it quenches thirst, and stops vomiting." By the mention of a *small jhambìri*, it is presumable there was another variety which was larger, and went by the same name. Whether by *jhambìri*, the *kaghzì nimboo* or lime proper of moderns is meant, it is impossible to say.

Prof. Cowell of Cambridge states that *jambhìra* also occurs in the *Amarakosha*, the oldest Sanskrit dictionary, of about the eighth or ninth century A.D.

Baber, 300 years ago, also mentions the *jhambìri*, but by that he evidently means the one I have described in the chapter on the *jhambìri* group, and figured in pls. 131 and 132, and not the true-lime, or *kaghzì-nimboo*, for he distinctly says "it is like an orange, but is not an orange." In Rumphius' Flor.

* In Séville they grow two oranges. The Séville or bitter orange, and the *small China*, which is probably no other than the mandarin.

Amboin., there is no citrus that can be identified with this orange-like *jhambìri,* and Loureiro, in his list of citrus of Cochin China gives nothing that approaches it. In the *Hagkala* Garden, Ceylon, I saw a citrus which appeared to belong to this group, but I never saw it in the markets. I never met with it in South India. The fact is, the true-lime or *kaghzì-nimboo,* has been found so useful, and is so easily raised from seed, all over India, that it has replaced most sour citrus, and if it were not still kept in the gardens of native gentlemen, as a curiosity, this *jhambìri,* would probably, by this time, have become extinct. Who can tell how many forms of citrus, raised from seed, may have become extinct, on account of there being no demand for them, owing to their being devoid of any very useful qualities. In the time of Risso some of the varieties he described were rare, because nobody but enthusiastic collectors cared for them, while those with good commercial qualities were becoming vulgarized.

Anyhow, this *jhambìri* appears to be unknown out of India, and not improbably it may be an Indian variety. It may have originated from seeds of the *sùntara,* or *keonla* group, which it resembles in form. I have not been able to trace the meaning of the word.

Turunj, Bajoura, and *Madhkaree.*—The first is evidently not an Indian name. Rumphius, in chap. 35, vol. ii., on the citron, refers to a philological discourse on the origin of the word *citrus,* by Bauhin., libr. I., Cap. 25, where the latter comes to the conclusion that the *etzador* of the sacred Scriptures means this fruit. Hence the Chaldean name of these fruits —*Extrogin,*— in the singular *Etog* or *Etrog,* and hence also the Arabic *Atrog.* Then in chap. 36 of the same volume, under *Limo tuberosus,* Rumphius goes on to say, "Similarly *Torong* and *Toronga,* which the

Arabs call *altrung* and *ottrog*, although properly speaking *Torong* is Persian. From this, the Spanish *Toronja** has come." All research regarding this citron, goes to show that in Media and Persia it was known from a very ancient date. Alph. de Candolle says : "The Greeks had seen the citron in Media and Persia in the time of Theophrastus, three centuries before Christ. In fact Citrus medica, and Malum Persicum, both meaning the citron, were given to it from the names of those countries. With these names this tree was first imported into Europe, being the first citrus that found its way there. De Candolle says that, according to Targioni, the citron was, after many attempts, cultivated in Italy in the third or fourth century.

The questions that now remain are—How and whence did it come to Media and Persia? No author says that it is indigenous there. Did it come there from India or elsewhere?

Prof. Cowell says that "*taranj*, an orange,† occurs in the Sikander nàmeh of the Persian poet, Nizàmi, who died about A.D. 1200." Baber, 300 years ago, said the sweet citron was common in Lemghanât, and the sour one in Bajour. Sir J. Hooker, in his "Flora Indica," says it is found wild in the valleys along the foot of the Himalaya from Gurhwal to Sikkim; in the Khasia mountains, Garrow mountains, Chittagong, the Western Ghâts, and in the Satpura range, in Central India.

Rumphius says that the citron is not frequent in the islands of the Malay archipelago. They are

* In Spanish I am told it is written *toronja*, but pronounced *toronkha*.

† Prof. Vambèry also says that now-a-days *turunj* means also an orange of a particular kind.

more plentiful in Java. A certain variety, however, is called "*lemon Java*, because there it is supposed to be indigenous." Loureiro says it is only found "*cultivated*" in Cochin China and China. This need not, however, militate against the citron having been of Chinese origin. Alphonse de Candolle gives several cultivated plants, whose *wild* forms appear to have become extinct. And, in spite of want of evidence in Chinese books, I would say that if the *orange* had its birthplace in China, the citron must have originated in the same place. For it would be unreasonable to suppose that two fruits structurally identical could have been evolved in two places, from two distinct centres. Of course it may be quite possible that the ancestral form of the citron became *improved* into our modern form, *after* it had left China, either in the Malay archipelago, or some where between China and India.

Taking everything into consideration, however, it still appears doubtful where the citron proper, *citrus medica*, originated. That it found a resting-place in India is highly probable, whence it may have found its way to Persia and Media, and eventually to Europe, about the third or fourth century of our era. It does not, however, follow, that it was not re-introduced in India, from two or more different directions. From Persia it probably found its way to Bajour and Lemghanât, and eventually into Northern India again, under the name of *bajoura*. It is not likely that this latter name is of Sanskrit origin (*bîja-puré*—full of seeds). It is truly full of seeds, but as the sour citron was plentiful in Bajour, it is more likely that some were brought to India from there, and retained the name of *bajoura*, or *bajouri*. Then Lemghanât was noted for *sweet* citrons ; and it is not unlikely that the large

melon-like sweet variety of Almora and other places, now known as *mudhkakree* may have been introduced from there. Finally, we have near Cochin in South India a Jewish colony, settled there so early as 490 A.D. As the citron was known in Media before the Christian era, and as the Jews made use of its fruit in their religious festivals, it is not at all improbable that this Jewish colony brought the citron fruit, or seed, with them to Western India, where it may have become naturalized. The varieties on that coast are more numerous than in other parts of India. In Ceylon it is called *siderun*. This clearly indicates its origin either from the Portuguese *cidra*, or the English *citron*.

As to the derivation of the sweet variety called either *mudkanker* or *mudhkakree*, Prof. Cowell says, "the first part seems to be the Sanskrit *madhu*—sweet; but Sir Monier Williams gives in his Sanskrit Dict. *madhukukkuti*—a kind of citron, with ill-smelling blossoms. As *t* always can become *r*, this is the same as your *Madhukakree*. This, however, is not an *old* Sanskrit word. It only occurs in comparatively modern dictionaries."

Kakree or *kanker* is the name of a sort of melon, and this sweet citron of Almora, being as large as a melon, the name of sweet melon, or *madhkakree*, may have been given it.

On the Western Coast of India, the citron is also called *mauling* and *ma'palà*. I have not been able to trace the derivation of these words. The former may not impossibly be connected with the *baleng* of Baber.

The Lemons.—The lemon proper is considered by botanists as a variety of the citron. *C. medica var. limonum*. The foliage of the lemon proper is different

from that of the citron ; but in the many varieties of the Indian *bajoura,* intermediate forms both of foliage and fruit are found. It should be noted, however, that the European lemon of the English shops, is essentially a product of careful selection and cultivation. According to Alphonse de Candolle, the Arabs carried the lemon from Oman to Palestine and Egypt in the tenth century. Not improbably in Oman itself the citron had been already considerably "lemonized," the latter fruit being more useful. He also says Palermo and Tuscany had them about the middle of the thirteenth century. Many of the lemons of the English shops, imported from Sicily, even now bear traces of their citron origin, in their thick skin and rough furrowed and subwarty exterior. In plate 200, *a* and *b,* is given a lemon, which Mr. Webster, B.C.S., found in the "tarai" among forest trees. It had a thin though solid skin, like the hard skin of the citrons. It is impossible to say whether it was indigenous there or naturalized.

Risso, in his monograph, gives many intermediate forms, under the name of lemons, between the citron and the best and most common lemon of all—his *C. limonum vulgaris.* The latter was recently introduced from Malta into Lucknow. Thence it was sent to many parts of India, and very recently I sent plants of it from Etawah to many other parts, including the Punjab, Assam, Bangalore, and Tinevelly in South India. In Ceylon, on some of the plantations, they have the lemon, probably also of recent introduction.

No one, as far as I am aware, has endeavoured to trace the origin of the word *lemon,* as far as it could be traced.

Colonel Yule, in his "Glossary," p. 391, says : "But

it has come into European languages through the Arabic *leimùn.*"

Rumphius, under *Limo tuberosus martinicus*, says: "As these kinds of fruit were not accurately described by the old authors; they were given the general name of *Mali Citrii*, *Medici*, or *Hesperici;* in subsequent times, however, their species were more carefully studied, and one was called in Latin *Limonium;* and in Pharmacopœias *Limonem*. . . . In vain may any one search for the derivation of this name in European languages. The Arabic word is *leytun;* the Persian *limum.*"

Mr. Gubboy informed me that the common Arabic name for lemon is *lùmi.* This very name is still retained in Malta for the lemon. Risso gives a whole section under the name of *Lumia*, and according to De Candolle, "an author named Falcando mentions in 1260 some very acid *lumias*, which were cultivated near Palermo." Now the word *limum* could very easily be corrupted, by transposition of the vowels, into *lumi.* But Colonel Yule gives *leimùn* also as the Arabic word. The lemon is not indigenous in Arabia. Where, then, did they get both the fruit and its name?

I think Rumphius gives us the solution of this puzzle in his Flor. Amboin. Under *Limo tuberosus maritinicus* he says, "It should certainly be noted that all the species of lemon (it should be remembered that by "lemons" Rumphius means *all kinds of citrus*) are called by the Malays, by the general term of *lemoen*, while in Europe this name is given only to *one* species. This tree (*Limo tuberosus*) moreover is called *Lemo martin* by the Malays. How it got this name, however, is quite unknown to me, but it seems likely that it may have first come into notice through

a Portuguese of the name of Martin, and hence its name." This is the only variety that Rumphius connects in any way with a Portuguese, and Martin might as well have been, I believe, a Dutch name.

Further, under *Limo tuberosus*, Rumphius says, "Generally they call all lemons (citrus) *aussi* or *ussi*, among the Amboinese; *lemon*, among the Malays; *djodji*, in Ternaté; *lemo*, in Macassar; *jeroc*, in Java; *djoboc*, in Baleya, *usse*, in Banda; and *cam*, among the Chinese."

In order to satisfy the reader further, I herewith give a detailed list of Rumphius' names in Latin and Malay:—

Latin.	*Malay.*
Limo decumanus (pummelo) .	Lemon cassomba.
Malum citrium (citron) . .	Lemon sussu.
Limo tuberosus . . .	Lemon martin.
Limo ventricosus . . .	Lemon purrut.
Limo agrestis . . .	Lemon papeda.
Limo taurinus . . .	Lemon carbou.
Limo ferus	Lemon swangy.
Limonellus (*kaghzi nimboo*) .	Lemon nipis.
Limonellus aurarius . .	Lemon maas.
Limonellus madurensis (perhaps *kumquat*)	Lemon madura.
Aurantium acidum (Séville orange)	Lemon itam.
Aurantium sinense (*sùntara* orange)	Lemon manis tsjina.
Aurantium verrucosum (Portugal orange)	Lemon manis bezaar.
Aurantium pumilum madurense	Lemon suassi.

From the foregoing list it will be seen that among the Malays it is not only some *particular variety* that may have been *introduced*, which is called *lemon*, but the *whole genus citrus*—oranges, lemons, limes, citrons, and pummelos—are called by this generic name. I think this distinctly points to this word being of Malay origin, or other indigenous origin, and that Arab traders got their *leimun* or *limum*, and *lumi* from the Malay *lemon*, and possibly the Portuguese may have reintroduced the word into Europe, under the modified name of *limon*; Anyhow this word must have existed among the Malays long before the Portuguese had doubled the Cape in 1497. And it must have existed there, probably, also before the Arabs began their intercourse with the Malay archipelago; otherwise its being used as the *generic* term for *all* the citrus is not explainable. Many kinds of citrus must have had their birth in the Malay archipelago, as one of the first resting-places of this genus, in its migration from South China.

The lime and the lima.—The true lime (*Kaghzi nimboo*) is found all over India. Natives call it indifferently *nimboo* or *limboo*, and in Bengal *lemboo* is a generic name for *all* citrus.

In Baber's time *a limoo* was plentiful in India, whether the same as *Kaghzi nimboo* of moderns or not, it is impossible to say—not improbably it was.

Professor Cowell says that *nimbùka* is not a true Sanskrit word, and that it is not an *old* word. He does not think that the Persian *limù* is derived from that word. In India, however, *nimboo* and *limboo* are indifferently used for the lime, and as I said, in Bengal *lemboo* means *any* citrus.

While the *kaghzi nimboo* among the Malays is called the *lemon nipis*, in Macassar it is called *lemo capàs* (from its being of the size of a cotton-pod) and in

Ternaté, *lemo Java.* In both these places *lemo* is a generic term for citrus, and the word may be no other than a modification of the Malay *lemon,* by dropping the *n.*

As I have stated in the chapter on the *lima,* there is a suspicion that the true lime had its birth as a new seedling variety in the Malay archipelago, and that not improbably its remote wild ancestor was the *C. hystrix.* Rumphius' *Limo aurarius,* a very small *kaghzi nimboo,* with the *large winged petiole* of its not improbable ancestor—the same C. hystrix—is, in my opinion, very suggestive. In Rumphius' time this variety (*kaghzi nimboo,* or true lime) found *only* in cultivation everywhere, was "vulgatissimus et usitatissimus," and used for all sorts of purposes—in food, medicine, and in the arts. Moreover it was one of the kinds, owing to its keeping quality, which was taken on long sea voyages, and its seeds germinated very readily, even if dropped on the ground. What wonder, therefore, is it that it may have found its way to India by means of traders sailing up the coast of the Malay peninsula, and Burmah, and eventually to Bengal; bringing with it its name of *lemo*—afterwards changing into *lemboo, limboo,* and *nimboo.* There is evidence of a very ancient trade between the Malay archipelago and India (*vide* Appendix, No. 40). In addition to this *lemo,* which is common to both places, I have discovered two other words which are common to the Malay archipelago and India, viz., Capàs—cotton; in Macassar this *kaghzi nimboo* is called *lemo capas,* from its being of the size of a cotton pod; and *cassomba*—Rumphius says this is a dye made from the "Carthamus tinctorius," which is the *kussumb* of India, and the pummelo from its *red* colour, in Malay is called *lemon cassomba.*

Either Rumphius or others may have also latinized

the Malay word into *limo*, and the Portuguese may have made *lima* out of it, whence came the English *lime* of the West Indies. It would appear that the words *lime* and *lemon* have a common origin, and come to us from the Malay archipelago.

In Ceylon the lime is called *déhi*. I have not been able to trace the derivation of this word.

There are other names of Citrus in use in India to denote particular varieties. The sweet lemon is called either *mitha nimboo* or *amratphal*. Prof. Cowell says this is evidently the common Sanskrit word *amrita-phala* (immortal, or ambrosial fruit). *Amrita* and *mrita* meaning undying, and *phala*, fruit.

Similarly, he says, *sadàphal* comes from the Sanskrit *sadà*, always, and *phala*, fruit—meaning, fruiting all the year round. This name I found given to more than one variety.

Karnphal, applied to the *khatta* in Almora, appears to be no other than the fruit of the *karna*, which is sometimes applied to the *khatta orange*, but really belongs to the Séville, as it means bitter.

Kuthairee-nimboo appears no other than the *jack-fruited* nimboo, from its size, *kuthal*, or *kuthar*, meaning the jack fruit.

Shunkhadràv, and probably *sungdaràz*, applied to some kinds of sour Citrus, are said to mean *shell melter*, from the extreme acidity of their juice. Perhaps in the same way that some call the *amil-bêd* "suigul," from its melting a needle stuck into it.

Then *Behàri* and *Gungoli nimboo* are names probably taken from Behàr and Gungoli-hât in Almora.

Ras kanker probably means a *juicy kakree*. It is applied to the *kathairee nimboo*.

Gulgul I have not been able to trace. Some suggest its derivation from a round sweetmeat of that name. Nor have I been able to get at the meaning of *beora.*

Karmaranga is said to be some sort of orange mentioned in Sanskrit books, but Prof. Cowell says it is not an old Sanskrit word, and found only in modern lexicons. I have never met with any Citrus of that name.

Then there are the Bengali names of Citrus. *Pâti nimboo* is said to mean *dèsee nimboo,* belonging to the country, in contradistinction to *foreign. Gòra nimboo* is said to mean extremely *acid* nimboo.

Kalàma and *kalamba* are uncertain. I am told there is a kind of pumpkin, used for keeping persons afloat while swimming, that is called *colàmba.* Not improbably the *kalamba,* which is a large pumpkin-like Citrus, may be named after that, or it may be derived from *calappa,* a cocoa nut, mentioned by Rumphius.

Further, *màha nimboo,* as applied to the pummelo by some, means *large Citrus. Bhimra,* probably from *Bhim,* the Indian Hercules, may have pretty much the same meaning, viz., a *huge Citrus.* There may be other fanciful names given by learned people with reference to some prominent character of some particular Citrus.

Attàrra nimboo is a large variety, which I met with in the Central Provinces. I have not been able to trace its derivation. Not impossibly it may be connected with *attar,* with reference to the scent of its rind or flowers.

Saròti nimboo also occurs. Prof. A. Vàmbèry suggests that this word may possibly be of Turkish origin, and derived from *sari,* yellow, and *ati,* flesh, or pulp,

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meaning a fruit with a yellow pulp—"if such an assumption corresponds with the natural character of the said fruit."

The derivation of the "làroo" of Poona, I have not been able to trace; nor of the "bàndir" of Tanjore.

CONCLUSIONS.

Some of the results of my researches may, perhaps, be summed up as follows :—

(*a.*) The pubescence on the young shoots and underside of the leaves of the pummelo (C. decumana, Willd.) cannot be considered a *specific* character, as *other* huge Citrus have it also, and some pummelo trees *have it not.* About this I may say that there is no doubt in my mind. The pummelo appears to be a huge form of some other Citrus, probably an orange, and may have owed its hugeness to conditions of luxuriance in a tropical climate.

(*b.*) The separation of the *sweet* oranges into *two* distinct races, viz., the Portugal close-skinned orange (C. aurantium sinense of Gallesio), and the Indian loose-skinned *sùntara*, or *sùngtara* (Aurantium sinense of Rumphius). Of this also I have no doubt.

(*c.*) That the name *sùntara* has nothing to do with the name of the town of Cintra in Portugal, as has been supposed by many, and that *sùngtara*, one of its other names, may partially have come from *seng*, which, according to Rumphius, is the name of a variety of orange in China. Not improbably also, its other name, *kamala*, or *kamla*, may have come from *kam*, the Chinese generic name for orange.

(*d.*) The European words, lime and lemon, are very probably derived from the *generic* names of the Citrus in certain islands of the Malay archipelago.

There, according to Rumphius, the Citrus goes by the name of *lemo* and *lemon.*

(*e.*) It is probable that some huge forms of Citrus may have originated in a *fusion of two ovaries,* and that eventually, by reproduction from seed, the fusion was perpetuated, while its external signs became obliterated, in the same way that the signs of *separate* carpels in some Citrus are now completely obliterated.

(*f.*) It is, I think, more probable that the true-lime (C. acida of Roxburgh) has descended from C. hystrix of Kurz (now found wild in Burmah), than from the C. medica of Linnæus, as has been surmised.

(*g.*) I believe that the idea of the juice vesicles of the Citrus pulp being homologous with the essential oil cells of the rind and leaves, is put forth for the first time. It is, therefore, for others to judge whether this theory can stand. If so, the oil cells of the rind, of the leaves, &c., the juice vesicles of the pulp, the pollen grains, the buds, and probably also the ovules or seeds of the Citrus would be *homologous* organs.

APPENDIX.

No. I.

THE following is an account of the oranges, citrons, &c. of Hindostan in the time of the Emperor Baber. The words within brackets are those of the translators.

The memoirs of Zeher-ed-din Muhammed Baber, Emperor of Hindostan, written by himself (A.D. 1519) in the Jaghatai Turki, were translated by Dr. John Leyden and Mr. William Erskine, published in 1826. In these memoirs I find the following, regarding the orange tribe :—

(*a.*) *Nâranj* (or orange).—In India "they have besides, the *Nâranj* (or Séville orange), and the various fruits of the orange species. The orange grows in Lemghanât, Bajour, and Sewâd, where it is both plenty and good. The orange of Lemghanât is small but juicy, and pleasant for quenching thirst.* It is sweet-smelling, delicate, and fresh. It is not, however, to be compared with the oranges about Khorassân. Its delicacy is such that, in carrying the oranges from Lemghanât to Kàbul, which is only 13 or 14 "farsangs" (between 50 and 60 miles), many of them are spoilt by the way. They carry the oranges of Asterâbâd to Samarkand, which is 270 or 280 "farsangs" off (about 1,100 miles) ; but as these have a thick peel and little juice they are not apt to be much injured. The size of the oranges of Bajour may be about that of a quince. They are very juicy, and their juice is more acid than that of other oranges. Khwâjeh Kilân tells me that he made the oranges of a single tree of this

* It is evident from this that Baber, by *Nâranj*, could not have meant the Séville or bitter orange.

species in Bajour be plucked off and counted, and they amounted to 7,000. It always struck me that the word *nâranj* (orange) was accented in the Arab fashion, and I found that it really was so. The men of Bajour and Siwâd call *nâranj*, *nârank* (or perhaps rather *nârang*)."

(*b.*) *Limoo* (Lime).—"Another is the lime (*limoo*), which is very plentiful. Its size is about that of a hen's egg, which it resembles in shape. If one who is poisoned boils and eats its fibres, the injury done by the poison is averted."

(*c.*) *Tarànj* (or Citron).—"Another fruit resembling the *nàranj* (or orange) is the *tarànj* (or citron). The inhabitants of Bajour and Siwâd call it *baleng*. On this account marmalades of Citron-peel are called *baleng-marmalade*.* The Hindostânis call the *tarànj* the *bajòuri*. It is of two species. One is insipid and sweet, but of a sickly sweet, and is of no value for eating; but its peel is used for marmalade. The citrons of Lemghanât are all of this sickly sweet. The other is the citron of Hindostan and Bajour, which is acid, and its sherbet is very pleasant and tasteful. The size of the citron may be about that of the *Khosravi* musk-melon. Its skin is rough, rising and falling in knobs. Its extremity is thin and knobbed. The citron is of a deeper yellow than the orange. Its tree has not a large trunk. It is small and shrubby, and has larger leaves than the orange."

(*d.*) *Sengtereh* (or common orange). — "The *sengtereh* (or orange) is another fruit resembling *nâranj* (or Séville orange). In colour and appearance it is like the citron, but the skin of this fruit is smooth, and without any unevenness. It is rather smaller than the small citron. Its tree is large, perhaps about the size of the small apricot-tree. Its leaf resembles the *nâranj* leaf. It has a pleasant acid, and its sherbet is extremely agreeable and wholesome. Like the lime, it is a powerful stomachic, and it is not a weakening fruit like the citron."†

(*e.*) *Kilkil* (or large lime).—"Another fruit of the orange

* *Murebba-bâling*, in A. Pavet de Courteille's translation.

† It is difficult to identify this *sengtereh* — "in appearance and colour" like a citron, but with a smooth surface and having a pleasant acid. This description would rather point to the *khatta* of moderns. In the time of Rumphius there was a *seng*-orange in China.

kind, is the larger lime, which, in Hindostân, they call the *kilkil* lime (*kilmek* is the name by which it now goes).* In shape it is like a goose's egg, but does not, like the egg, taper away at the two extremities. The skin of this species is smooth, like that of the *sengtereh.* It has a remarkable quantity of juice."

(*f.*) *Jambîri* (or Jabiri).—" Another fruit resembling the orange is the *jambîri.* In shape it is like the orange, but it is of a deeper yellow. It is not, however, an orange, though its smell is like that of the orange. This fruit, too, yields a pleasant acid."†

(*g.*) *Sadàphal.*—" Another of the orange kind is the *sadàphal* (everlasting fruit, Hunter), which is shaped like a pear, and in colour resembles the quince. It has a sweet taste, but not so mawkish as the sweet orange."‡

(*h.*) *Amratphàl.*—" The *amratphàl* (*lit.* nectar-fruit) is another of the fruits resembling the orange." (On this notice of the *amratphàl* there is, in the Turki copy, the following note of Emperor Humâyun. It is not found in either of the Persian translations.) " His Majesty,§ whose abode is in Paradise, may Heaven exalt his splendour, has not attended sufficiently to the *amratphàl.* As he observed that it was sweet and mild tasted, he compared it to the sweet orange, and was not fond of it ; for he had a dislike to the sweet orange, and everybody, on account of the *amratphàl's* mild sweet, called it like the orange. At that time, particularly on his first coming to Hindostan, he had been long and much addicted to strong drinks, whence he naturally did not like sweet things. The *amratphàl* is, however, an excellent fruit. Its juice, though not extremely sweet, yet is very pleasant. At a later period in my time we discovered its nature and excellence. Its acidity, when unripe, resembles that of the orange. While yet very acid, its sourness affects the stomach,

* I never heard of the name "*kilmek.*"

† This description points to the *jhambîri* proper (which see), and not to the *khagzi-nimboo*, or lime proper.

‡ This description rather tallies with that of the *sadàphal* of moderns ; but any Citrus, bearing fruit *all the year round*, might be called *sadàphal.*

§ Meaning Baber.

but in course of time it ripens and becomes sweet."* "In Bengal there are two other fruits which have an acid flavour, though they are not of equal excellence with the *amratphàl.*† The one is called *kàmilah,* and grows to the size of an orange (*nàranj*); many hold it to be the larger lemon (*narang*), but it is much pleasanter than the lemon. It has not an elegant appearance or shape. The other is the *sàmteréh,* and is larger than the orange, but it is not sour, and is not so tasteless as the *amratphàl,* nor is it very sweet either. Indeed, there is no pleasanter fruit than the *sàmtereh.* It is a very fine shape, pleasant, and wholesome fruit. No person thinks of any other fruit, or has a longing for any other, where he can find it. The peel may be taken off by the hand, and however many you eat you are not surfeited, but desire more. It does not dirty the hands by its juice. Its peel is easily separated from its pulp,‡ It may be eaten after food. This *samtereh* is seldom met with. It is found in Bengal at one village called *Senargam,* and even in *Senargam* it is found in the greatest perfection only in one place. In general, among this class of fruits, there is no species so pleasant as the *samtereh;* nor, indeed, is there among any other."§

With reference to these two oranges the following occurs in a footnote:—"The *kamilah* and *samtereh* are the real oranges (*koungla* and *sangtereh*), which are now (about 1826) common all over India. Dr. Hunter conjectures that the 'sangtereh' may take its name from Cintra, in Portugal. This early mention of it by Baber and Humayun, may be considered as subversive of the supposition."||

* Humayun must have mistaken an unripe *kalan-kaghzi* for an *amritphàl.* The latter is acidless from beginning to end. (See sweet lemon, and *kalan-kaghzi.*)

† Even to this day the sweet lemon is a universal favourite among natives.

‡ There can hardly be any doubt that Humayun was describing the *sùntara* of modern times. It does not appear that the *sengtereh* of Baber, and the *samtereh* of Humayun are one and the same *thing*, although the latter *word* may be only a corruption of the former.

§ Even in modern times, natives think the *sùntara* the best orange of India.

|| This notion about the *sùntara* orange being the *Cintra* orange of Portugal has got into many books, but, as I have shown, it is the least likely solution to the derivation of *sùntara*, or *sùngtara.*

(*i.*) *Kirneh* (probably the *kirna*, a kind of citron). "Another of the orange kind is the *kirneh*, which may be about the size of the *kilkil* lime. This, too, is tart."*

(*j.*) *Amilbêd* (*lit.* the acid willow). "Another resembling the orange is the *amil-bîd*. I have seen it first during this present year.† They say that if a needle be thrust into the heart of it, it melts away.‡ Perhaps this may proceed from its extreme acidity, or from some other of its properties. Its acidity may be about equal to that of the orange or lime."

No. 2.

In *Blackwood's Magazine* for September, 1886, in an article by Major-General A. R. McMahon, on "Burmese border tribes, and trade routes," I find the following :—

"A century before the Christian era it appears that the emperor of the Han dynasty fitted out an expedition to find its way through South-West China to India, which was frustrated by the obstructiveness of the 'barbarians,' or Shans, who then occupied Yunnan. The result was the chastisement of the Shans, and their expulsion from the country of the Upper Mehkhong and Salween rivers to the Irawadi valley. This movement developed to such a degree that the immigrants, after a while, found themselves strong enough to overthrow the monarchy, established by the Aryan settlers (from India), and founded a kingdom of their own, of which more anon.

". . . . . Yunnan, which was formerly peopled by Shans, was by this pressure absorbed by the Chinese. . . . . The same fate overtook them from a different cause, in their contact with the Hindus of the Brahmaputra valley, which the

* The translators probably allude to the *khatta*, which is often called Citron by the English; it is, however, impossible to say whether Baber also meant this.

† In A. Pavet de Courteille's translation—"que je n'ai eu occasion de voir que depuis trois ans."

‡ In a foot-note—"This story of a needle is believed, by the natives, of all the Citron kind, which are hence called in the Dekhan *sui-gul* (needle-melter)."

Shans invaded in the eighth, and completely occupied in the beginning of the thirteenth century. They then arrogated to their own dynasty, says Mr. Mackenzie, the title of Ahom —the unequalled—softened afterwards into Assam. . . . .

"From ancient Shan records, discovered by Pemberton at Manipur, it would appear that in the beginning of the Christian era the whole of the region extending from the mountains on the south-east boundary of the Assam valley down to lat. 22°, and from the mountains, which separate Manipur and Kubo valleys on the west, to Yunnan on the east, was formerly known as the Shan kingdom of Pong, having its capital at Muang-Marong. . . . . Having existed for many centuries in great splendour, this kingdom, in the beginning of the eleventh century, was broken up by the conquests of King Anawrahta, the darling hero of the Burmese people.

"Eventually the Pong kingdom was overthrown by the Burmese, disintegrated, and incorporated with the Burmese kingdom.

"Though little trace is to be found of the glories of Pong in the Upper Irawadi, or the country to its west, we can turn with pleasure and interest to the little states of Manwyne, Sanda, Muangla, Muangtha, or Hotha and Latha, Muangwan and Muangmow, the relics of the Koh-Shanpyi, or nine Shan states, which, cradled in the parallel ranges between the Salween and the Irawadi, have preserved their subordinate independence, and represent the chief component parts of the ancient kingdom. . . . . Anderson records that the great body of the population is engaged in agriculture ; and as cultivators they rank even with the Belgians."

NOTE.—The points in this extract which I should wish to impress on the reader are (1st) that the Shans, having all the *savoir faire* of the Chinese agriculturists, came from Yunnan to the Brahmaputra valley. (2nd) That as the Chinese claim the orange as indigenous to their country, it is not likely that such industrious agriculturists would not have brought the orange with them, and established it wherever they settled, more especially as the orange is easily carried, and its seeds easily germinate, and produce fruit similar to the parent tree. If the *sùntara* orange had been introduced by them, its

spread along the hills facing India from Khasia to Bhotan, Nepâl, and Gurhwal, was only a matter of time.

No. 3.

The following is taken from the "Penny Cyclopædia" (1840), under the heading of *Orange* :—

"Since then, Dr. Royle has stated ('Illus. of Himalayan Botany,' p. 130) that he has found two plants, having the characters of the lemon and the citron, growing wild in the jungly valleys at the foot of the Himalayas, in the tract between the Ganges and Jumna rivers, which, when transferred to gardens, retained their characters. He further states that from the Rungpore forests a round kind of lime is obtained,* while in those of Sylhet, as well as on the sides of the Nilgiris, the orange† is described as being found wild. . . . . In England the orange and citron have been cultivated since 1492; and Mr. Loudon states that at the Wilderness, Kent, there are three trees in boxes (about 1840), not surpassed by any trees so grown in Europe; and that at Saltcombe, in Devonshire, there are in a few gardens orange trees which have withstood the winter in the open air for upwards of 100 years‡ (see the work of Risso of Nice, and Poiteau of Versailles, 'Histoire Naturelle des Orangers'; also Gallesio's 'Traité du genus Citrus,' and Mr. Loudon's 'Encyclopædia of Gardening')."

* Can this be the *jambîri* proper, which is a *round* sour citrus? More likely it is the *Rungpore lime* of Saharunpore.

† The Sylhet orange meant is probably the *sùntara* of these days; but the Nilgiri orange may possibly mean the Séville—both having been probably *introduced*.

‡ Not improbably the Séville orange is here meant, as it stands a greater degree of cold than other kinds, and hence probably its Italian name, "arancio forte."

No. 4.

The "Treasury of Botany" (by John Lindley and Thomas Moore) 1866, part I. p. 291, has the following:—

"The citron, orange, lemon, shaddock, and lime have been referred to various species of citrus, with regard to which botanists, however, are not agreed. It is even doubtful whether all of them, with their numerous varieties, have not originated from C. medica. On this point the following observations by Dr. Lindley in the 'Journal of the Hort. Soc.' (ix. 171), are important. He states that the above-mentioned fruits 'are all of eastern origin, and mostly introduced in Europe in comparatively modern days, but of very ancient and general cultivation in Asia. The varieties known are very numerous, and difficult to reduce according to their species, on the limits of which botanists are much divided in opinion. Those who have bestowed the most pains on the investigation of Indian botany, and in whose judgment we should place the most confidence, have come to the conclusion that the citron, the orange, the lemon, the lime, and their numerous varieties now in circulation, are all derived from one botanical species—Citrus medica—indigenous to, and still found wild in, the mountains of East India."

(NOTE.—Why the C. medica in particular should be considered to have been the grand-parent of all other kinds is not clear. If we go back far enough into the history of plants other genera also might perhaps be all included as descendants of some more remote progenitor.)

From the same source as the foregoing, the following is taken: "The Jews cultivated the Citron at the time they were under subjection to the Romans, and used the fruit then, as at the present day, in the feast of Tabernacles; but there is no proof of their having known this tree in the time of Moses. It is likely they found it at Babylon during their captivity and brought it to Palestine on their return. Whatever may have been the diffusion of the species in Western Asia at that remote date, there is no evidence of its having been indigenous to Media, nor have modern travellers

found it wild in Persia; but Dr. Royle found the species in the forests of Northern India. The Citron is cultivated in Cochin China and in China, but Thunberg does not mention it as existing in Japan. Taking all the above facts into consideration, it is evident that the species is originally from the north of India, and as the habitat of every one of the orange tribe is naturally rather limited, Prof. de Candolle does not think that this extended, in the case of the Citron, as far as the north of Persia. Probably the Citron was carried in that direction and also into China at a very early period. In many countries they are easily naturalized. The seeds sow themselves in several of the colonies — for instance, in Jamaica. . . . . The so-called Madras Citron has the form of an oblate sphere.* In China there is a variety with its lobes separating into finger-like divisions, and hence called the fingered-citron.

Regarding the C. aurantium the following occurs: "It was not, at the time of Alexander the Great, in that part of India which he penetrated (about 327 B.C.); for it is not mentioned by Nearchus among the productions of the country which is watered by the Indus. But the Arabs, carrying their conquests further into India than Alexander (at a much later period and probably after 664 A.D.), found the orange more in the interior; and according to Prof. Targioni it was brought by them into Arabia in the ninth century. Oranges were unknown in Europe, or at all events in Italy, in the eleventh century, but were shortly afterwards carried westward by the Moors. They were in cultivation at Séville towards the end of the twelfth century, and at Palermo in the thirteenth, for it is said that St. Dominic planted an orange-tree for the convent of St. Sabina in Rome in the year 1200.† In the course of the same thirteenth century the crusaders found citrons, oranges, and lemons very abundant in Palestine; and in the following or fourteenth century both oranges and lemons became plentiful in several parts of Italy. . . . . The first orange-trees, it is stated, were imported into England by Sir W. Raleigh and reared by his relative, Sir Francis

* Probably this is not a *citron* at all.

† I have been informed that the tree said to be planted by St. Dominic is still in existence (1888).

Carew, at Beddington in Surrey. These trees are mentioned by Bishop Gibson, in his additions to Camden's 'Britannia,' as having existed for a hundred years previous to 1695; but finally they were entirely killed by the great frost of 1739–40, after they had attained the height of 18 feet, with stems 9 inches in diameter. Trees of the orange tribe naturally live to a very great age in a soil and climate which suit them. Even under artificial treatment there are some remarkable instances of their longevity. There may be seen in the orangery at Versailles a tree which was sown in 1421. It is growing with its roots in a large box, and appeared very healthy when we saw it lately (about 1866). The orange-tree at the convent of St. Sabina at Rome is thirty-one feet high, and said to be upwards of 600 years old. At Nice, where the tree may be considered naturalized, growing quite in the open air, there was in 1789, according to Risso, a tree which generally bore 5,000 or 6,000 oranges, and which was more than 50 feet high, with a trunk which required two men to embrace it. In Cordova, the noted seat of Moorish grandeur and luxury in Spain, there are orange trees still remaining, which are considered to be 600 or 700 years old."

"Under favourable circumstances the productiveness of the orange is astonishing. In an account of the gardens and orange grounds of St. Michael's, in the Azores, by Mr. Wallace (Journal of the Hort. Soc., vii. 236), we are informed by the author, who resided at St. Michael's for several years, that the orange grounds vary from 1 to 60 acres in extent, and are surrounded by high walls and tall-growing trees as shelter, not from the cold but from the sea-breeze. The grounds are rarely occupied wholly by orange-trees, for limes, citrons, lemons, guavas, &c., are scattered about in them. Orange-trees were first introduced into the Azores by the Portuguese. There are only two kinds of oranges cultivated at St. Michael's, viz., the Portugal and the Mandarin. Many varieties of the former exist, and they are greatly improved by the genial climate of St. Michael's. The Mandarin orange has not been many years in the island, nevertheless, there are some trees of it 14 feet high. This capital little orange has lately been exported to England, where it realizes a higher price than the common St. Michael's. The largest

orange-tree which Mr. Wallace measured was 30 feet high, the stem being 7 feet in circumference at the base;* but many larger trees, destroyed by the coccus, had been cut down. The produce of the trees is almost incredible; props are always used to prevent the weight of the fruit from breaking down the branches. An orange-tree in the quinta, or orange-garden, of the Barão das Laranjeiras produced twenty large boxes of oranges, each box containing upwards of 1,000 fruit—in all 20,000 oranges from *one* tree.† Two hundred shiploads of oranges are annually exported from St. Michael's being nearly 200,000 boxes."

R. THOMPSON.

All the foregoing extracts are taken from the before-mentioned "Treasury of Botany."

No. 5.

Dr. John Shortt, writing from Yercaud, Shevaray Hills, dated 26 October, 1885, says: "We have only one kind of citron here which attains to a good size, about a foot or more long, and weighs from 3 to 5 lbs. The common warted citron and the fingered citron, as it is termed, are met with at Bangalore, and I have seen the fruits exhibited at the Madras Horticultural Show. We have the lemon, which attains to the size of about a goose's egg, and the lime about that of a hen's egg, but quite round and not oval or oblong. There are two other sorts in which the fruit is as large as the cocoa-nut without its husk. The one is quite round, and the other of the size of a large orange, and pointed at the summit (with a mammilla). We have not the sweet lime. I introduced a plant of the latter, but not having fruited yet I cannot say what it is.

"Of oranges we have the Seville, a bitter orange; the

* Presumably a tree of the *Portugal* variety.

† To over-crop a willing tree is almost as bad as to over-drive a willing horse, *vide* Appendix, No. 32, on the disease of the Orange trees in the Azores in 1836; also Appendix, No. 41, Rumphius's chap. 42, on the Aur. sinense ("*sûntara*" Orange).

chinee, sometimed termed *Batavia,* a large, smooth-skinned fruit; then the *kamala,* or loose jacket, of which there are two varieties, a large and a small kind. The common country orange, termed *kitchlee* about Madras, and *kolinge* up here, is an indifferent, rough-skinned fruit.

"We have the pummelo, which fruits largely—some weighing four to five pounds—but is worthless, as the pulp is acrid, bitter, and sour. The pummelo is a most delicious fruit about our coasts, both the white and pink varieties; but plants or seeds introduced up here, from excellent fruit-bearing trees on the plains, become worthless. It is probably the fault of the climate or soil. Most of the pummelos I have eaten in the various districts of Madras, excepting this place, were delicious. Formerly the pummelo fruit was purchased at one rupee per 100, and the rind used, it was said, for flavouring country 'arack,' but now even this demand has ceased."

No. 6.

The following is part of a letter from Dr. John Shortt, dated "The Retreat," 12th July, 1886, Yercaud, Shevaray Hills, S. India.

"Had you come, you could have seen all the varieties of the orange, lime, lemon, citron, pummelo, &c., in fruit. The large orange known in Tanjore (*bandir*) is called about Madras the *Sathghur* orange, from the name of the village, about forty miles from Madras, at the commencement of the Mysore plateau. It is also known as the *chinee* or *buddachinee*; whilst in the northern districts of this Presidency it is called *Batavia* orange. It is a very fine fruit, and attains a large size when well grown. On these hills the fruit does not attain anything beyond the medium-sized orange. Between this and Bangalore you can see all the varieties of citron. Our best pummelo comes from the vicinity of Pondicherry and Cuddalore—both the pink and white fleshed varieties. Some good ones are to be had at Arcot also.

"Yours, &c.,

"JOHN SHORTT."

NOTE.—From Dr. Shortt's letter it would appear that the *bandir* orange of Tanjore is of *foreign* origin. Rumphius, in chap. 43, vol. ii., *Aur. verrucosum*, describes a variety of the Portugal orange, and says that the fruit is about the size of two fists ; that it is more juicy and sweeter than the *Aur. sinense* (*sùntara*), and that the Amboinese call it *Lemon Tsjina*, "as this is mostly cultivated by the Chinese inhabitants."

No. 7.

In the *Gardeners' Chronicle* for 24th April, 1886, p. 534, F. F. states that the citrus plants in Kew are "polygamo-monœcious, bearing male, and occasionally a few hermaphrodite flowers."

NOTE.—From my own observations I found that there is scarcely one variety of orange, lemon, or lime which is not polygamo-monœcious. In 1886 one tree—a sweet lemon—was covered with bloom, but about seventy-five per cent., or more, were only males, with the ovary and pistil rudimentary. Only a very small percentage had a well-developed ovary and stigma. I think it the general character here (Etawah) of cultivated citrus to have male and hermaphrodite flowers on the same tree. The sweet lemon in question did not set more than two or three fruit that year, although it usually bears many more. I am not prepared to say that the pummelo should not be included in the same category. I did not make special observations on the flowers of the pummelo, but noticed a very large number of well-developed ovaries and pistils among the open flowers of the pummelo trees.

No. 8.

Sir C. F. Bonham, writing from Cintra on 2nd Sept., 1886, in connection with the Portugal orange, kindly added the following extract, taken from an old book :—

"Extract from the 'Herball, or generall historie of Plantes,' gathered by 'John Gerarde,' of London, Master in Chirurgerie, and imprinted in London by John Norton, A.D. 1597.

"'The citron, limon, and orange trees do grow especially in the sea coates of Italie, and on the Islands of Adriatic and Tyrrheni, and also Œgicei maris, and likewise on the mainland neere unto meeres and greate Lakes. There is also greate store hereof in Spaine, but in places especially adjoining unto the sea, or not farre off. They are also found in certaine provinces of France, which lie upon the Midland Sea. They were first brought of Media, as not only Plinie writeth, but also the Poet Virgil affirmeth in the second booke of his Georgickes, writing of the Citron Tree after this manner:—

"'"The country Media beareth juices sad,
And dulling tastes of happie citron frute,
Than which no helpe more present can be had,
If anytime stepmothers, woorse than brute
Have poisoned pots, and mingled herbs of sate
With hurtfull charmes: This citron fruite doth chase
Black venome from the bodie in every place,
The tree itself in growth is hughe and big,
And very like in show the Laurell tree,
And would be thought a laurell leaf and twig,
But that the smell it castes doth disagree;
The flower in holde, as fast as flower may be,
Therewith the Medes a remedie do finde
For stinking breathes and mouths a cure most kinde,
And help old men, which hardly fetche their winde."'"

No. 9.

In the "Pharmacopœia of India," by Edm. John Waring, M.D., p. 45, the following occurs:—

"Citrus Bergamia (Risso).—The lime-tree—commonly cultivated in India and other tropical countries . . . . closely resembles the lemon, but is smaller in size, with a smoother, thinner rind, and of somewhat less fragrant odor. Its juice (lime juice) has the same pungent, acid taste, &c., &c."

NOTE.—The author is evidently describing the common

kaghzi nimboo of India, but the wonder is how has the mistake of calling it C. Bergamia of Risso come about (*vide* Appendix, No. 55)? The latter is the *Bergamotte*, used in Europe, principally in perfumery, for its essential oil, and very different from the common true lime of India. Sir J. Hooker, in his "Flora of Br. Ind.," p. 515, vol. i., says of the Bergamotte, it is "rarely cultivated in India." In all my researches I have never met with it in India, and Mr. Duthie tells me he has not either. Rumphius does not describe any variety that can be taken for it. Loureiro does not mention it in Cochin China. It is probably a variety raised from seed in Southern Europe.

No. 10.

In the *Gardeners' Chronicle* of April 24th, 1886, p. 534, under the heading, "Oranges not fruiting," the following is stated:—"In a small-fruited form of Citrus medica, only a small percentage of the blooms are hermaphrodite, and have a well-developed pistil, with a long style and capitate stigma, protruded beyond the stamens. These latter only may be expected to bear fruit, if the flowers happen to set. A small plant of Citrus limonum flowers profusely every year at Kew, but bears no fruit. The ovary remains small, and the style is very short and rudimentary, with little trace of a stigma. The pollen appears perfect, but does not effect fertilization, even if applied to the rudimentary pistil. The defect in all probability pertains to the latter, and appears to be more universal than in the case of C. medica, mentioned above. All of the above cases may be seen in the economic house at Kew, where the plants are practically polygamo-monœcious, bearing male, and occasionally a few hermaphrodite flowers. Of course this may apply to young or small plants only,* or to conditions of culture and surroundings. The 'Genera Plantarum' does not mention this fact, and in Le Maout and Decaine's work the flowers of the Aurantiaceæ are said to be generally hermaphrodite. In an allied group of the same

* *Vide* Appendix, No. 7.

order the flowers are polygamo-diœcious, of which *Skimmia japonica* is a well-known instance. The species and varieties of Citrus above mentioned show a nearly similar tendency."

F. F.

No. 11.

Gardeners' Chronicle, July 3, 1886, p. 15:—"Oranges in Valencia and Cordoba.—The orange crops in Valencia, Spain, appear to be suffering much from the competition from the large and increasing crops of Florida and California, thereby closing the U.S. markets to the Valencia crop. The loss of this outlet causes excessive exportation to Great Britain, and consequently unremunerative results. The quantity of oranges exported from Valencia during the season, from November to June, amounted to about 2,000,000 cases. From Cordoba, however, the bitter orange is exported in increasing quantities. It is much grown in this district, and during the last five years the produce grown has increased from 2,000 boxes to 6,000; one box contains 500 oranges. They are all shipped to London and Liverpool, and are used for making marmalade."

No. 12.

Gardeners' Chronicle, Aug. 14, 1886.—A trip to Chiriqui (one of the West India Islands ?). By J. Hart, Jamaica:—

Page 201.—"Limes are plentiful, but oranges are scarce, rendered so by the constant attacks of the We-we (ant) upon the leaves of the tree."

No. 13.

Gardeners' Chronicle, Sept. 9, 1886, p. 467:—

"*The Orange Crop in Valencia.*—As an illustration of the importance of the orange crop in Spain, it is stated that from

the port of Valencia alone over 3,000,000,000 oranges have been shipped in the course of one season. The fruits, which are considered the best of their kind in Europe, can now be delivered in England at 9s. the box, leaving a fair margin of profit to the producer."

No. 14.

In the *Gardeners' Chronicle* of July 17, 1886, p. 77, there is the following :—

"*Orange culture in S. Francisco.*—In a recent Government report on the products of S. Francisco, it is stated that there are about 12,000 acres planted in orange trees in Los Angelos county, now bearing fruit, and several thousand acres in young trees, which will begin to bear fruit in from two to five years' time. In S. Bernardino county, the orange crop has, at intervals of from three to four years, been greatly damaged by frost. At less frequent intervals, the same trouble has been experienced in this county. . . . . Oranges are being shipped from Mexico to the Eastern States. Should the reciprocity treaty come into effect, the consequence will be very serious to orange growers here. The present duty is sufficient to protect Californian orange growers from competition with the cheaply-produced Mexican article. As the Mexican oranges are of better quality, their admission free of duty would cripple the industry here.

"The 'white scale' is still doing immense damage to the orange trees. Some of the oldest orange orchards in the country are being topped and pruned to such an extent that they will not bear any fruit for several years. In some cases the trees are being cut down. No cheap effectual remedy has as yet been discovered to destroy the insect ; it is stated, however, that another insect has appeared which preys on the 'white scale,' and is not injurious to the orange tree."

NOTE.—There can be little doubt that when large tracts of any country are covered with *one* kind of plant, sooner or later some insect or vegetable parasite that feeds upon it, will appear—whether the plant be that of the orange, the

vine, the coffee, &c. Sometimes another insect will also be called into being, which may keep the former in check. If not, either an antidote must be found, or the trees must eventually succumb. Insects multiply by millions in a very short time, and the evil must be checked, if at all, at the commencement.

No. 15.

In Baron Hubner's "Through the British Empire," the following occurs:—

(*a.*) Vol. i., p. 50—"A disease, hitherto unknown, having lately destroyed nearly all the orange plantations, which constituted erewhile the glory of Paarl" (South Africa).

(*b.*) Vol. ii., p. 127. Writing of the Shalimar Gardens of Lahore:—"The squares formed by the rectangular paths are filled with mango, fig, and gigantic orange trees, more than two centuries old, whose thick branches interlace each other aloft."

(*c.*) Vol. ii., p. 269 (Australia):—"By the uncertain glimmer of the twilight we see, shining against the dark background of Norfolk pines, the golden apples of the Hesperides, the fruit of the gigantic lemon-trees, planted here by the convicts nearly a century ago, but which now, owing to the carelessness of the present inhabitants, are in danger of being smothered by the ever-encroaching forest."

(*d.*) Vol. ii., p. 325. At Loma Loma, Fiji:—"Gigantic orange trees gild with their fruit the dark vault of Mangroves."

No. 16.

(*a.*) "Imperial Gazeteer of India," vol. v., p. 296, under the head of Kashmir and Jamu states: "Neither orange, lemon, nor any species of citrus arrive at maturity in Kashmir, as the intense cold of winter proves fatal to them."

(*b.*) "Imperial Gaz. of India," vol. viii., p. 367, under the head of Sindh Province:—

"The fruits common to the country include dates, plantains, mangos, limes, oranges, citrons, pomegranates, grapes, figs, tamarinds, mulberries, and melons. The British authorities have lately introduced apricots, peaches, and nectarines with excellent results."

No. 17.

Gardeners' Chronicle, 12th June, 1886, p. 762.

It appears that in the Tuileries garden, Paris, there are 150 orange trees. It is said that "of this number forty-three trees date from the reign of Francis I. (1515–1547)," that is they are from 339 to 371 years old. Whether these are Séville or Portugal orange trees is not stated.

No. 18.

Dr. Brandis, in his "Forest Flora of India," mentions that, "In the South of Europe the orange attains a much larger size than in India. A yield of 3,000 to 5,000 oranges per tree annually is not rare. Near Milis, on the Island of Sardinia, there are trees more than six feet in girth (nearly 2 feet across), and are said to be 700 years old.* The wood of the orange is hard, close and even-grained, and yellowish ; it weighs forty-nine pounds when seasoned, and sixty-five to seventy pounds when green (Skinner). In South Europe it is used for turning, engraving, inlaid and cabinet work, and excellent walking sticks are made of shoots and branches."

* These must be Séville or *bitter* oranges, as "Haydn's Dictionary" says the *sweet* orange was first brought to Europe by the Portuguese in 1547—that is about 339 years ago.

No. 19.

St. James's Budget, 3rd July, 1886, p. 8, *Persia as a Playground*:—

"The orange groves of Enzelli, on the Caspian, run down to the water's edge."

No. 20.

Mr. C. Nickels, of the Passewa Factory, Jaunpore, writing on 27th January, 1886, says:—

"I had a great collection of oranges, limes, and lemons in my garden; but a blight attacked my trees, and the greater part of them were killed, including the *kaghzi nimboo*, and those that are left are sickly."

No. 21.

"Faramòsh," or Indian "Philippine."

On the 1st August, 1886, I found a double lemon (shown in pl. 223, figs. *a* and *b*), formed by the fusion of two ovaries. I was told that when any double fruit, such as mango or other, is found, a sort of game is played with it, as with the *English Philippine.* The finder of this double fruit presents it to some one. If the latter takes it into his hand, the former says *faramòsh* (forgotten), and exacts 200 of the same kind of fruit. If on the contrary, before taking it he says *yâd* (remember), then he forfeits nothing. They also play it by agreement—English fashion. It is a great game among native children. Whether it was the Europeans or the Orientals who originated this game I do not know. I had never heard of this *Indian Philippine* before.

No. 22.

In the *Gardeners' Chronicle* of 20th June, 1885, p. 793, regarding the oranges of the Argentine republic, I find the following :—

"The orange was originally imported into the basin of the river Plate, but it soon multiplied to a great extent, and now, in certain localities, grows wild, sometimes forming veritable forests. The Lower Parana, and the islands which form its delta, are covered with these trees. They are also found more or less numerous on the islands of the Upper Parana, on those of Uruguay, and sometimes even on the borders of those rivers. Further up those rivers, the orange becomes more frequent in the forest of Missiores, as well as those of Paraguay.

"On the lower islands of the Parana and Uruguay, the fruit is somewhat bitter and sour; but further north, and especially in the province of Corrientes, in the Missiores, and in Paraguay, they are deliciously sweet and of very large size. The orange is produced perfectly from the seeds, and these being scattered everywhere by the parrots, which are exceedingly fond of the fruit, explains the fact of its general dissemination. . . . . The tree (from seed) commences to bear fruit at the age of six years, and is in full bearing at eight years. It is of very robust habit, and is perfectly proof against drought and locusts, the two worst plagues of agriculture in the Argentine Republic. . . . . The lemon is grown all over the republic, and is very prolific, not merely producing two crops per annum, but maturing a continual succession of crops."

No. 23.

In the same number of the periodical above named, p. 791, there is a note on the oranges of Jamaica. In 1875, 4,673,820 oranges were exported from Jamaica to the United States. In 1884, 41,639,500 were exported.

"The export of oranges," the article goes on to say, "is increasing by rapid strides, as will be seen from the above. The demand for orange plants is in excess of all other plants from the Public Garden, and this would indicate that the regular cultivation of the orange tree is being taken up with spirit and energy."

No. 24.

In an article in *Chambers's Journal* for December, 1883, p. 717, on "Orange Farming," the following occurs:—

"Making every allowance for the circumstance that nine or ten years must elapse between the periods of sowing orange seeds and gathering the crop, should grafting or budding not be resorted to, it will probably be found that, among the long catalogue of cultivated fruits, the orange tribe afford the most satisfactory financial results.

"Hitherto, it appears, only capitalists embarked in orange and lemon growing, on account of the time the tree requires to come into full bearing. But a person with a trade or profession, if he possesses a bit of land, with good soil, in the right climate, can do worse than invest his savings in sowing orange and lemon, &c. seeds of the proper kind, and raising plants in nurseries, and plant out by degrees, until his land is covered with the most valuable kinds of citrus. It is capital well invested, which will last for generations with ordinary care. Every part of the tree is valuable."

This article goes on to say that "the members of the orange family number fully 200 varieties, and although originally hailing from the tropical banks of an Indian river,* these have now spread into most lands, becoming rapidly acclimatized, or modified, wherever they have been cultivated, under even the most moderately favourable circumstances. Where, on the other hand, individuals of the family, such as the lime in the West Indian island of Monserrat, have been introduced into a specially congenial climate and soil, they

* Which *kind* of oranges, I would ask, hailed from the banks of an Indian river?

evince a degree of superiority that astonishes persons acquainted only with the limes of the East.

"The lime-farming industry of Monserrat dates from 1852. Mr. Burke commenced the first orchards, and now the Monserrat Company owns more than 600 acres, on which are 120,000 lime-trees. The amount of lime juice exported to England alone is said to be more than 80,000 gallons a year.

"In the island of Trinidad oranges are largely cultivated, including the Portugal Silver and St. Michael oranges. In 1877 a trial consignment shipped to London from that distance is said to have been pronounced the best then offered in the market, except similar varieties received about the same period from Brazil, the former selling for eight shillings a box of 100 oranges, and the latter fetching eleven shillings."

"In Trinidad the trees are reared about 25 feet apart, thus admitting sixty-five or seventy trees per acre. The smallest average yielded in unfortunate seasons is 500 oranges per fruiting tree, and the highest average 1,000. Taking the lesser crop as an example, the whole harvest will seldom fall below 32,500 oranges, which at the modest price on the spot of five shillings a hundred, shows a gross return of £81 5s. 0d. per acre. It is a curious circumstance connected with the rearing of this favourite fruit, which fits in admirably with the necessity which exists for plucking it in a green state when sent to a distant market, that the trees from which unripe fruit is gathered bear plentifully every year; whereas those allowed to fully ripen their oranges only yield abundant harvests during alternate years."*

"It may prove interesting to know that foreign cattle are particularly fond of lemons, and that in Brazil the herds eat greedily of the fallen fruit."

* I have noticed in the English markets that some oranges of the Portugal type had little flavour. I attribute this to their having been plucked *too unripe*. The best I have tried were those from Florida, and they appeared to have been fully ripened on the tree. Later in the season (May) I found those from Spain very fine flavoured also.

No. 25.

In the "Sydney Visitors' Guide," p. 51, I find that at Parramatta, on Mr. Pye's estate, is an extensive orange grove. The guide book says: "Here may be seen growing every variety of the orange and lemon and other members of the citron family, from the tiny *kumquat* to the gigantic shaddock. Indeed, the orange plantations of Parramatta may be said to be quite phenomenal, not alone in their extent, but in their marvellous productiveness and the uniformly good quality of their fruit. To those who have not seen the orange growing in a congenial home, or who may but have seen it under the rude culture of some of the growers of the European continent, a visit to the celebrated estate of Mr. Pye of Rock Hall is not likely to be soon forgotten."

Mr. J. H. Thornhill, C. E. Canal Department, India, who has recently taken a trip to Australia, tells me, "I drove for about three hours in a sort of circuit from Parramatta, and outside the town was never out of sight of orange-trees. They said you might double the distance with the same result, and that the cultivation of the orange is largely increasing."

No. 26.

Regarding large oranges, the *Tropical Agriculturist* of 1st June, 1883, p. 962, has the following taken from the *Trinidad Chronicle* of 21st February, 1883. An orange-tree produced fruit of an extraordinary size, more like a shaddock. For several years it gave several crops of big fruit. In 1882–3 one was of great size and weighed 20 ounces, with a girth of 13 inches.* They have a thick skin "little inclined to turn yellow." The pulp is "sweet as of other oranges" in Trinidad. Other oranges of the same tree are said to have been even bigger than the above. The owner had a hope of obtaining a race of monster oranges.

* The "bandir" orange of Tanjore is 12 inches in girth.

No. 27.

In the *Gardeners' Chronicle* of 1st August, 1885, p. 154, under the head of "Florida, the Italy of America," I find that "Florida may be termed a Horticultural State, oranges being at present the staple industry. The demand for the fruit far exceeds the supply, notwithstanding the thousands of acres planted with orange-trees. A twelve-year old tree will bear as many as 1,500 oranges, and it will be difficult to conceive what the demand will be when the foreign trade is developed. The first shipment to London was by W. H. Sands, Esq., who sent several boxes this spring, the returns for which barely covered the cost. Another gentleman shipped some later on, which paid him a better return. A direct line of steamers from Florida to the old country is what is wanted. The cost of an orange grove depends on the quality of the land and its locality, 10 acres being an ordinary sized grove, and 50 trees to an acre. There are two ways of raising the trees—from seed, and by budding stocks with whatever variety you want. The latter will bear in four years.

"The lemon and lime also do well. In Florida vegetables are grown in winter, the summer being too hot for successful cultivation of vegetables in the open unshaded fields. They can however be raised in the orange groves, between the trees, while the latter are coming into bearing. The average pay of labourers is 1¼ dollars (5 shillings and 3 pence) per day, skilled workman being better paid. Carpenters and gardeners especially are wanted. Wages for the latter run about 27 dollars per month, with board; without board, 37 dollars is about the highest price paid. The hours of labour are longer than in the old country. The cost of living is much higher, many articles being double in price."

No. 28.

In *Blackwood's Magazine* for September, 1885, p. 316, there is an article, entitled, "Florida, the state of orange groves."

The writer says:—"The Florida orange is a delicacy by itself, hitherto unknown to the world, and which Spain need never attempt to rival. Between an Indian river orange, and the coarse-grained, spongy, bitter-sweet product of the Mediterranean, there is nothing whatever in common. The one is a thing to be eaten in the usual routine of life, the other is a delicacy which we can only hope to stumble on at rare moments. A ripe Floridian, well grown, and in good condition, melts in the mouth like a juicy peach. It is nectar in poetic form; and the fashionable mode of eating it in Jacksonville is to cut it in two, and empty it with a teaspoon. So delicate is the pulp, and so tender the skin, that the one difficulty in enjoying it is the handling of it."* . . . .

"In tropical countries the winter is generally the wet season, and what it lacks in cold, it makes up in damp, and a general atmosphere of rheumatism. But Florida has its rain in the summer; at Jacksonville, they register from fifty to sixty inches of rain per annum, the average being about fifty-four inches. More than two-thirds of the fall occurs in the months of June to October inclusive. . . . . The oldest of the orange groves in Florida is under fifteen years. . . . . Strangers are told that natural trees (seedlings) will bear in seven or eight years, and budded ones in five or six; but that is a different thing to getting from them fine-flavoured fruit. After the seventh or eighth year, they improve every season, and with careful cultivation, they should have attained a full measure of juiciness, and delicacy by their twelfth year. There seems to be no historical limit to their fruitfulness. Trees of mythical age exist in various parts of the state, which have had 5,000 oranges in one crop. It is a fine

* Those I saw in the London shops did not come up to this description. They were very fine flavoured oranges.

bearer, however, that keeps up a good average of 500 a year.

NOTE.—If the writer lumps the Mediterranean oranges into one set of "coarse-grained, spongy, bitter-sweet" things, it is evident that either he has never been there in the orange season, or he must have tasted only inferior varieties. Another mistake he makes is that "in tropical countries, the winter is generally the wet season."

No. 29.

In *Chambers's Journal* for January, 1885, p. 797, on "Orange culture in Florida." It says :—

"The orange tree will bear in five years from the bud, or ten years from the seed ; but a man left in charge—say the son of the owner—would have no difficulty in supporting himself by the sale of small fruit, which coming to perfection in the middle of winter, commands the best prices in New York, and other northern markets. In ten years, oranges are handsomely remunerative, and the crop steadily increases in value with every succeeding year. For those who cannot wait so long, the lemon and lime may prove more attractive, as they bear much sooner. They are almost as profitable, though not quite so hardy.

"The old cry 'go West' is now changed to 'go South,' and thousands of families from the Northern States are there, having orange and lemon groves."

Another correspondent in the same article says : "The most absorbing question of interest to the greatest number now, however, is the great money-making business of orange-growing, which is peculiarly adapted to the Florida soil and climate. Since I first visited Florida in 1873, this industry has gone far beyond the commercially experimental stage, and I have been an eye-witness to its undoubted success.* It is particularly interesting and instructive to travel over districts now, and observe *bearing* orange groves, the owners of which are securing handsome incomes, where ten years

* *Vide* Appendix, Nos. 30 and 31.

ago not a tree was planted. In Orange county many emigrants, who first went to Florida for their health, have improved sufficiently to earn their living, and raise an orange grove in addition. Many of them took up 160 acres of land, under the Homestead Law, and selling off portions of it to later comers, have realised enough money to cultivate the balance retained. Others, who knew a trade, worked part of their time for their neighbours, and spent their unemployed hours in planting an orange tree here or there for themselves, until they finally had a five or ten-acre grove, of sixty trees to the acre, which, when bearing, would give them an annual income of from £300 to £1,000."

No. 30.

In *Chambers's Journal* of 19th September, 1885, p. 604, are given the experiences of a sojourner "In the Orange Groves of Florida," which show the other side of the picture.

He says that one must be prepared for a hard lonely life, and plenty of hard work. Soil there was none; only sand, white as flour, and as fine, and tenacious weeds without number. But from what he saw, during a residence of some time, he thought that "given the *right situation*, abundant, and appropriate food, and that devoted attention, which it claims,* and the orange tree seems to offer as certain a return for money, time, and skill as any investment in the old, or new world."

He goes on to say, "From what I saw, I consider the orange to be the most responsive of all arboreal things to human touch." And he adds, "The oranges of Florida are already the largest in the world, and their quality is unequalled by the choicest fruit of Europe, of Syria, and Brazils."

He informs us, however, that cockroaches, mosquitos, and all insect life in Florida are "a huge and permanent afflic-

* There's the rub! Most fruit trees would do the same, under similar conditions, not only in Florida, but in many other places. (*Vide* Appendix 31.)

tion," and "as horticulture is the only business that can be carried on in Florida, and as insects are vastly destructive to fruits and vegetables, it is the height of folly to annihilate the small birds. The orange tree is the prey of many insect parasites, and sometimes a whole grove is blighted by them. I have seen scores of trees ghastly with 'scale,' and owners almost driven to desperation. Indeed, the difficulty is to keep the trees clean. Nothing struck me more than the contrast between the fruit of the groves, often black and wrinkled, and the brilliant plumpness of the wild oranges in the hummacks. I believe the health and beauty of the latter were owing to the birds, which preyed upon insects, their natural food, whereas from the groves birds were banished, as every boy found his pastime in blazing away at them." Finally he says, "The outcome of my personal experience is, for the settler to begin upon a small scale, taking care of his capital, and his health. The cleverest man must go upon facts; and though hints and book instructions can help, they cannot make an orange-grower."

NOTE.—Then to sum up, all the advertising of this new Eldorado in Florida, appears to come to this—that by capital, hard labour, skill and patience, you can grow in Florida a good kind of orange, that will fetch a good price, in winter, in New York. That is, provided you keep your health, and do not mind the "huge and permanent affliction" of cockroaches, mosquitos, &c.; but whoever wishes to learn more about it may do so, by turning to p. 185, of the *Saturday Review* of 6th February, 1886.

No. 31.

In the *St. James's Budget* of 6th March, 1886, the following occurs on p. 11, under the head of "Florida frosts":—

"The winter of 1885–6 will for long be remembered by the people of Florida. . . . . Every day during the 'blizzard' the faces of the orange and 'truck' growers were getting longer and more gloomy, till, it is no exaggeration to say, a panic prevailed. The crop of fruit upon the trees was of course irremediably destroyed; every orange had become a

block of ice. Nursery stock, which had already been stripped of its leaves by the earlier frosts, was now killed outright, predicting the utter annihilation of the orange groves throughout the whole of our section."

The frost appears to have been very severe for Florida. On the 9th January, 1886, the thermometer marked 40 degrees, Fahr., at noon. On the 10th, 34 degrees at noon, and 24 degrees at 9 P.M. On the 11th it did not rise above 30 degrees at any time, and on the 12th 34 degrees was again the highest point reached. These figures were taken from a thermometer partially protected by a veranda, so that the orange trees in the open must have been exposed to still lower temperatures.

In 1883-4 there was also a bad frost, and also in 1876.

A month after the disaster, however, says the writer, "the groves are again putting on leaves, and not much damage has been done to the trees. But the loss of the crop and nursery stock was a heavy blow."

NOTE.—The remedy for all this would appear to be to raise a hardier variety of citrus. Any kind which survives a bad frost would be the best for that locality. Risso states that in the south of Europe, where the orange was at one time largely grown from seed, hardier varieties often turned up, so that, by their means, the orange tree could be pushed further north, without injury from frost.

No. 32.

In the *Tropical Agriculturist* of 1st December, 1882, appeared the following :—

" In the Azores, up to 1836, the orange trees were in perfect condition—no care, no attention, no labour, was given them, save that of picking and packing." . . . . They were left " without manure, without draining, and may be without pruning." . . . . Suddenly, however, a disease appeared, " trees 200 and 300 years old, and producing each 6,000 to 20,000 oranges, were disappearing." It was observed that all the trees affected produced a *very heavy* crop the very year

that the disease manifested itself, that the leaves became yellow and fell off in great quantities, and on the trunks or stems near and sometimes beneath the ground the bark opened, and drops or tears of yellow gum exuded, and hence the disease was called *lagrima*, from the Portuguese word for tears."

NOTE.—This orange disease of the Azores appears to have been studied and its history become known. An effectual remedy has been applied, a great part of which appears to have been *common sense*, and *rational treatment* of a tree so responsive to human care and attention. There would appear to be a curious notion that plants can be maltreated to any extent, and still go on living and producing money for their owners for ever.

The people of the Azores gave "no care, no attention, no labour, save that of picking and packing the fruit." Naturally "without manure, without draining, and may be without pruning" the original fertility of the soil was exhausted, and the trees sickened and died. The inference is that the people richly deserved what they got—the destruction of a fine industry, the far famed St. Michael's oranges. The people danced and amused themselves while the orange-trees bore fruit. The same probably happened in Ceylon with respect to coffee. The planters amused themselves while a million hundredweight of coffee-beans were extracted from the soil and exported. The planters awoke one day to find their coffee industry destroyed. Probably similar causes have destroyed the vine and potato industries in other places, viz., too much reliance on the original fertility of the soil, with the hope that it may prove inexhaustible. All these histories of ruined industries are very instructive lessons to those who can profit by them.

No. 33.

Mr. Vaz, Chief Engineer of the s.s. *Chanda*, B. I. S. N. Co., told me that "in 1873 he went with Mr. H. O. Hume to the Nicobar Islands. On one island he saw growing in a wild state sweet oranges, of which he gathered two basketsful and

took them on board. At the time there were no natives on that island. Besides these sweet oranges, which, he said, "had a tight skin, and exactly like the Colombo oranges," they found on that island papayas, cocoanuts, little sour limes, and little sour oranges, like *kumquats*, the largest of the latter being about ½ inch in diameter.

As in Colombo, I found several varieties of oranges, I could not make out to which Mr. Vaz alluded.

No. 34.

In the *Tropical Agriculturist* of 1st June, 1883, taken from the *Gardeners' Chronicle*, regarding the Sorrento oranges, it is said that oranges and lemons are extensively cultivated at Sorrento, in the South of Italy. "Land on which oranges grow lets at £27 per acre. All the oranges exported are measured by passing them through a ring, and they only pack those for export which are of *uniform size.* Lemon juice was sent in casks to England (I believe mixed with lime), but it was intended to start a citric acid factory at Ischia."

No. 35.

The *Gardeners' Chronicle* of 26th December, 1885, p. 818, further says that, "Regarding the development of the green fruit trade of Sicily, it is stated that efforts have recently been made to form an association to further its growth. Within the last few years this traffic, which is so important to the island, has suffered considerably. The fruit markets of the United States, of England, and of the Adriatic have been overstocked by a superabundance of oranges and lemons, supplied to them from Spain and Portugal, as well as from Sicily; and in the United States this trade will eventually suffer still more from the rivalry which California (and perhaps Florida (E.B.)) is creating. Success very much depends on selection of the fruit, its speedy transition to its destination, and regularity in reaching the same, so as to avoid

overstocking the market. Amongst the commercial transactions the Association proposes to make, are to establish agencies in different parts of the world, and to establish factories for the manufacture of lemon-juice and essences. In November, 1884, eight steamships left the port of Palermo for the United States laden with green fruit, numbering 24,811 boxes of oranges, and 47,269 boxes of lemons, being 4,603 boxes of oranges less, and 11,903 boxes of lemons more than in the same month of 1883. In December, 1884, thirteen steamships left Palermo for the United States with green fruit on board. They loaded at this port and other ports of the island 80,298 boxes of oranges and 57,191 boxes of lemons, showing as compared with the same month in 1883 a diminution of 40,185 boxes of oranges and 63,234 boxes of lemons. The green fruit crop of Spain having totally failed, it is hoped that Sicily will reap the benefit of the disaster and towards the beginning of the present year prices had gone up in England. In January last sixteen British steamers and two Italian vessels were employed in the fruit trade with the United States, carrying a total of 54,778 boxes of oranges and 62,359 boxes of lemons from Palermo, a diminution of 55,416 boxes of oranges and 62,359 boxes of lemons. The exporters have thus kept back their produce and not overstocked the market."

While the preceding facts come from the British Consul in Palermo, Vice-Consul Franck of Catania says, under the head of "Oranges and Lemons," "These important products, which a few years ago promised to become a branch of commercial resource to the island, have proved instead a failure to all those who turned their fields and grounds into orange and lemon groves. Prices in America (the chief country where exported) are so very low, that it is more convenient for the producers to let the fruit rot on the trees than to go to the expense of packing it up for exportation."

No. 36.

In the *Tropical Agriculturist* of 1st January, 1883, p. 591, I read the following interesting note on the orange trade of Great Britain, taken from the *Morning Post*. It says:—

"Importations of oranges in London commence in October from Palermo, Valencia, West Indies, and Brazil. Real St. Michael's come in *later*, about Christmas. It is said that the St. Michael's orangeries were becoming diseased, like those of the other islands of the Azores group, such as Terceira, Fayal, and St. George's, which once produced a large quantity of fruit. The great bulk of the oranges come from Valencia, and other neighbouring Spanish ports—perhaps more than one half—and the trade of these ports has been constantly increasing; also from Lisbon, Villa Real, Aviero, and Oporto. Consignments also arrive from the Azores, Brazil, Palermo, Malta, and other Mediterranean ports. From St. Michael and Brazil oranges are separately wrapped in the leaves (envelopes of the cobs) of Indian corn, while those from all other places come wrapped in thin paper. Blood oranges come mostly from Valencia, and a few from Malta; and the aromatic and delicious Tangerines (Mandarins) from St. Michael's, and also from Lisbon. Séville oranges come from the place of that name in Spain, and are used extensively for making marmalade and orange wine. For both these purposes, however, the Palermo 'bitters' are really better adapted. It may not be generally known that the best marmalade of all is produced from the shaddock.

"The head-quarters of the orange trade in London is Pudding Street, Lower Thames Street. A package of oranges contains, on an average, 400. In 1881–2 nearly a million packages were landed in London. Glasgow receives a large and increasing number. Bristol and Hull account for many thousands of packages. In 1881–2 over two and a-half millions of packages were imported into Great Britain."

No. 37

In the *Gardeners' Chronicle* of 2nd January, 1886, p. 23. under the head of "Colonial Notes," the following occurs:—"The orange trees at Natal give out from the snowy masses of bloom the strongest and most delicious scent," so that it is probable, in many places of South Africa, oranges are largely grown.

No. 38.

In the *Century* for January, 1886, p. 325, S. G. W. Benjamin, in an article on the city of Teherān, says, "The oranges of Ghitan are large and handsome, but inferior in flavour to those of Sicily."

No. 39.

Dr. Masters's "Teratology."

(*a.*) Cases in which the citrus was observed to be monstrous or abnormal.

p. 137—Prolification of the flower.

p. 149—Axillary prolification (flower bud).

p. 364—Polyphylly of the gynæcium (augmentation in the number of carpels).

p. 453—Enation from the carpels (horned projections from the ovary, like the cornute oranges of Ferrari, Gallesio, Risso, &c.).

p. 56—Adhesion of the embryos.

p. 134—Alteration of position, and repetition of carpellary whorl.

p. 303 and 310—Pistillody of the stamens (stamens becoming pistils).

p. 502—Double flowers.

It would appear that next to Antirrhinum majus, Anemone, Aquilegia Canadensis, Brassica oleracea, Daucus carota, Dianthus, Digitalis purpurea, Fuchsia, Primula sinensis, Rosa, Trifolium repens, and perhaps Vitis, the genus most subject to changes in its various parts is the *Citrus*, according to Dr. Masters.

The following are also taken from Dr. Masters's "Teratology" (Science of monsters and malformations):—

(*b.*) p. 5—"Buds, as it seems, may be found in any situation, though their ordinary position is in the axil of a leaf, or at the end of a stem or branch."

(*c.*) p. 29.—Cohesion of Stamens. "In many cases the so-called cohesion is due to the formation of numerous secondary stamens, from one original staminal tubercle, so that the process is rather one of over-development than of fusion, or of disjunction."

(NOTE.—This view might probably be applicable to the formation of *compound* leaves, from the original tubercle of a *simple* leaf.—E. B.)

The citrus appears especially prone to adhesions of its various parts.

(*c.*) p. 33. Adhesions of two leaves—"the two upper or inner surfaces may become adherent, as in an orange, where two leaves were thus united, the terminal bud between them being suppressed or abortive.

(*d.*) p. 35. Adhesion of *stamens* to *pistils* in the orange.

(*e.*) p. 44. Synanthy, or *adhesion* of *flowers*, was observed among others in the Citrus aurantium.

(*f.*) p. 48. "In some cases of Syncarpy the fusion and interpenetration of the carpels is carried to such an extent that it is very difficult to trace on the outer surface the lines of union. The fruit in these cases resembles a single one of much larger size than usual."

Vide double lemons, Pls. 223 and 224.

(NOTE.—It is my belief that the pummelo, and probably

other huge citrus also may have originated in this way (*vide* pl. 83). If the fruit resulting from such fusions bore seed, it is probable that this double character of fruit might be perpetuated, and become fixed. Not improbably also additional carpels might occur, by a sort of proliferation.—E. B.)

(*g.*) p. 54. *Grafting.*—"And a still more curious illustration may be cited in the fact that it has also been found possible to graft a scion on the leaf in the orange."

(*h.*) p. 74. Fig. 32 gives a drawing of an "anomalous form of orange."

(NOTE.—I have hazarded an explanation of this anomaly on pl. 241, fig. *d.*—E. B.)

(*i.*) p. 75. "Disjunction is not rare in oranges. Sometimes this takes place regularly, at other times irregularly; occasionally in such a manner as to give the appearance of a hand and fingers to the fruit."

"M. Duchartre mentions a semi-double flower of orange with eight to ten distinct carpels in a whorl, and occasionally several whorls, one above another. De Candolle considers the rind of the orange as a production from the receptacle, and this view is confirmed by the specimens of Duchartre, in which the carpels were quite naked, or had a common envelope truncated, and open above to allow of the passage of the styles and stigmas."

(NOTE.—I should say that not only the rind but all parts of the fruit are productions from the receptacle. The fact of Duchartre having found the pulp carpels quite naked or rindless admits, as I have shown, of a different interpretation, and may only prove that the *pulp* carpels are quite distinct from the *rind* carpels.—E. B.)

(*j.*) p. 134. *Prolification of the fruit.*—"In many instances, not only the fruit is repeated, but also the outer portions of the flower, which wither and fall away, as the adventitious fruit ripens; so that, at length the phenomenon of one fruit projecting from another is produced. It is obvious that this form of prolification in no wise differs from ordinary central prolification. Sometimes some of the whorls of the adventitious flower are suppressed; thus M. Duchartre describes some orange-blossoms as representing alternating series of

stamens and pistils one above another, while the calyces and corollas belonging to each series of stamens and pistils were entirely suppressed. In other cases, doubtless, the carpellary whorl is alone repeated, the other whorls of the adventitious flower being completely absent."

"Another condition, apparently sometimes mistaken for prolification of the fruit, is that in which the carpellary whorl becomes multiplied, so that there is a second or even a third series within the outer whorl of carpels. If the axis be at all prolonged, then these whorls are separated one from the other, and produce in this way an appearance of prolification. This happens frequently in oranges, as in the variety called Mellarose."

(*k.*) p. 335. *Dimorphism.*—Two or three cases cited by Mr. Darwin from Gallesio and Risso. "Gallesio impregnated an orange with pollen from a lemon, and the fruit borne on the mother tree had a raised stripe of peel like that of a lemon, both in colour and taste, but the pulp was like that of an orange, and included only imperfect seeds. Risso describes a variety of the common orange which produces rounded-oval leaves, spotted with yellow, borne on petioles, with heart-shaped wings; when these leaves fall off they are succeeded by longer and narrower leaves, with undulated margins, of a pale green colour, embroidered with yellow, borne on foot-stalks without wings. The fruit, whilst young is pear-shaped, yellow, longitudinally striated and sweet; but as it ripens, it becomes spherical, of a reddish-yellow, and bitter."

(*l.*) p. 369. "Increased number of embryos" (such as the germination of two or more from the same seed).

(NOTE.—This I believe is only the repetition of the *multiple* normal buds of the axillæ of *all* Citrus.—E. B.)

(*m.*) p. 389. "*Pleiotaxy of the gynœcium*" (augmentation of the number of the carpellary whorls).

"The orange is one of the plants most frequently subject to an augmentation in the number of carpellary whorls; sometimes this is due to the stamens assuming the guise of carpels, but at other times the increase occurs without any alteration in the stamens, or other organs. If the adventitious carpels be exposed, they are covered with yellow rind,

while those portions that are covered by the primary carpels are destitute of rind."

(NOTE.—Risso gives pictures in which the inner carpels are distinctly covered with rind—oil-cells; and Rumphius gives also instances of orange within orange (*vide* pl. 241, *b*, in which the innermost whorl is shown to be composed of *rind* only).—E. B.)

No. 40.

(*a*.) The following dates, collected from various sources, may possibly be of some use to future investigators of the origin of the different kinds of citrus in India.

"Several ancient nations, particularly the Tyrians and Egyptians, carried on commerce with India.

"It was partially conquered by Darius Hystaspes, who formed an Indian Satrapy 512 B.C."

"And by Alexander the Great, 327 B.C."

"And subsequently the intercourse between India and the Roman Empire was much increased."

"Authentic history of Hindostan commenced with the conquest of Mahmoud of Ghuzni in 1004. Irruptions of Mahomedans under this leader occurred between 1001–24 A.D."

The above are taken from "Haydn's Dictionary of Dates."

"A Jewish colony assert that they possessed Cranganore, sixteen miles N.W. of Cochin, so early as 490 A.D., and they say they hold a copper grant to this effect from the Hindus."—*Pioneer Mail*, 26 January, 1887.

"Whitaker's Almanac" says that: "So early as 664 A.D. Arabs began to make predatory expeditions against Bombay and Sindh." There must, however, have been friendly intercourse between the Arabs and Persians and India long before that, otherwise how could the colony of Jews have got to Cochin so early as 490 A.D.? The descendants of this Jewish colony still exist at Cochin.

(*b*.) Through the courtesy of Professor Cowell, of Cambridge, and his friend Dr. W. Wright, Arabic professor, the following book was brought to my notice, where I might

find something about the intercourse of Arabs with the East in early times. My object was to discover how early trade was carried on between the Arabs and India and China, with a view of obtaining some idea of the chances that the various kinds of citrus might have had of becoming disseminated through their means. The book in question is called, "Relations des voyages faits par les Arabes et les Persans dans l'Inde et la Chine, dans le IXe siècle de l'ère Chrétienne," translated from the Arabic by M. Reinaud, and published in Paris in 1845.

It consists of accounts related by a merchant named Soleyman, who made several voyages between Persia, India and China. At page 12 he relates that the merchandise (coming from China) is small in quantity and dear at Busra and Baghdad. One of the reasons for this is that fires are frequent at *Khanfou*, where houses are made of wood. *Khanfou* is a Chinese port, and an *entrepôt* for merchandise belonging to Arab and Chinese merchants. Another reason is the shipwrecks which occur on the outward and homeward voyages. Then the ships are liable to be plundered, or are forced to make a long stay in certain places, which obliges the merchants to dispose of their goods out of Arabia, &c. &c.

At page 13 he says that the vessels for China start from Syraf, on the coast of Persia. This place serves as a convenient *entrepôt* for merchandise from Busra, Oman, and other places.

At page 15 he continues: After taking fresh water from Muscat, the vessels make sail for India, and after a month arrive at *Koulam-Malay* (Quilon); Malay being the common name for Malabar, or country of Mala. After provisioning, and taking in water, they again start for the sea of *Herkend*, and, passing that, they come to the islands of *Lenjcbalous*. The people there are naked, and come in boats to take iron in exchange for amber, cocoanuts, &c. Thence, the ships go to *Kalâh-bar* (*bar* means either kingdom or coast, and is probably on the Coromandel coast). Between this and Quilon is a month's voyage. The people of *Kalâhbar* wear a kind of cloth round their loins. In ten days more they get to *Betoumah* (or *Tenoumah*) for water if necessary, and thence to *Senef* is another ten days. From this place

aloes is exported, called *Al-Senfy.* In another ten days the island of *Sender-Foulat* is reached, where fresh water is also found. Finally, when, by God's help, ships get safe out of *Sender-Foulat,* they make sail for China, and arrive at *Khanfou* at the end of a month."

With a large variety of fruits in China, Soleyman mentions *le citron.* (9th century.)

Massoudi, a celebrated Arabic writer, according to Reinaud, lived in the first half of the 10th century A.D.

The publication of these tales (1st book) in Arabic was in the year of the Hegira 237 (851 A.D.), the epoch in which the commercial relations of the Khalifs of Baghdad with India and China were at their highest.

In the preliminary discourse, at page 28, Reinaud says: "The commercial relations between the Red Sea, Persian Gulf, and Eastern coast of Africa on the one side, and the Western coast of India on the other, are of great antiquity. There cannot be any doubt that this was the object of certain Phoenician expeditions, in which King Solomon wished to take a part. It was by this route that the products of Arabia Felix, of the coast of Sofala, and of India reached the Western nations. It was a commerce of great value. These commercial relations continued under the Greek kings after the death of Alexander. They were the basis of the greatness of Alexandria, in Egypt, for some time, and of Seleucia, on the Tigris. Nevertheless, the voyage was slow and troublesome, on account of the periodical winds called *maussam* (hence monsoon), and the ships were obliged to keep sight of the coast during their voyages.

All of a sudden, a Roman navigator, named Hippalus, conceived the idea that a shorter and more direct line to India than that of the coast might be followed. At a favourable season he started from the straits of Babelmandeb (with the S.W. monsoon) for the Gulf of Cambay. Six months later, he availed himself of the change of wind (N.E. monsoon), to return to his starting point. The example of Hippalus was followed by others, and so the commerce of spices and silk got an unprecedented impetus.

From that epoch the Chinese vessels, starting from the ports of the Celestial Empire, came to Java, Malacca, Ceylon,

and to the vicinity of Cape Comorin. There the exchange of the products of the East was made with those of the West. (*Vide* Appendix, No. 40, A.)

In the 4th century A.D., the commercial relations between the East and West had become frequent and regular. In the 11th century, the Romans had formed settlements at Aden, Arabia Felix, and on the Isle of Socotra, then inhabited by colonies of Arabs and Greeks, besides the indigenous people. The commercial activity of the Romans spread to the Persians, and from the very commencement of the Christian era, ships from India converged towards the Tigris and Euphrates.

Of course, with all these riches on the seas, the profession of pirates also came into existence, in which it is said the Indians of the West coast were not slow in taking part.

The Arabs naturally took an active part in this lucrative commerce. At first it was the Arabs who formed the greater part of the crews. Everything goes to show that, in combination with the Persians, they exercised from that time the same ascendancy, along those coasts, as the Portuguese in the sixteenth century did, after doubling the Cape. The influence of the Arabs and Persians increased as the prestige of the Romans diminished.

When, however, Mahomet came on the scene, the attention of all was turned towards him, and two years after his death, Syria, Mesopotamia, and shortly after, Egypt and Persia, fell into the power of Sectarians. Then followed religious troubles, and intestine wars, and all commercial relations became entirely upset thereby. But in the midst of the most rapid and astonishing conquests, in the sixteenth year of the Hegira (637 A.D.), under the Khalifate of Omar, a fleet starting from the coasts of Oman, went to ravage the countries at the mouths of the Indus, and the coasts of the peninsula of India. Before the end of the seventh century, a colony of Mahomedan merchants had already established themselves in Ceylon.

In the year 758 A.D., the Arabs and Persians were sufficiently numerous in Canton to get up a tumult in the town, and plunder it.

Towards the end of the seventh century, a Mahomedan

expedition took possession of Bahmanabad, Alor, and Mooltan, and so on, until the Cape route was discovered by the Portuguese, and things took a different course.

(NOTE.—From Reinaud's account, it will be seen that from a very remote period, Western Asia and Eastern Africa had commercial intercourse with India, the Malay archipelago, and China. This intercourse offered innumerable chances for many varieties of citrons being carried from China and Cochin China to the Malay archipelago, to India and Ceylon, and to Persia, Arabia, and Egypt. Then they could have been carried only by means of the fruit and the seed. Sown again at each place they became more or less naturalized, and improved or otherwise, by change of climate and soil, and in turn, new varieties arose through propagation by seed, till the citrons reached Southern Europe, and fell into the hands of professional gardeners, when probably other means of propagation were discovered, and the numerous varieties enumerated by Risso and Poiteau came into existence there. The discovery of the Cape route brought new varieties into Europe. Later on Europeans disseminated this useful genus in the West Indies, and also in America and other places.

There cannot be much doubt that the islands of the Malay archipelago offered suitable homes for the different varieties of citrus, and there can hardly be a doubt that many kinds now in India, or their ancestors, originally came from those islands. Many of the originals may possibly have become extinct, owing to better kinds having been raised from seed. The four words (probably there may be many more) viz.—*limboo* or *limoo*, *capas*, *kussumb* and *creese* or *krissen* (*vide* App. No. 66)—being common both to India and the Malay archipelago, indicate that intercourse between the two parts must have been more or less great. The word *usoh* of the Khasia hills, and *aussi* or *usse* of the Malays, and possibly the *udo*, of *udo dèhi*, in Ceylon, point to the same conclusion. With the exception, perhaps, of the citron, and some of its descendants, which may have been indigenous in India, or may have come across the Eastern border, and the *sùntara* orange, which may also have come directly from Yunnan, or Cochin China, across the Eastern border, there is no reason to suppose that all

the other varieties of citrus, including the *kaghzi nimboo* or lime, did *not* come to India, originally from the Malay archipelago.)

(*c.*) The following dates may also be of service.

"The Portuguese (Vasco de Gama) discovered the Cape route in 1497."—"Haydn's Dictionary."

"Vasco de Gama arrived at Calicut in 1498 A.D."—*Pioneer Mail*, 26 January, 1887.

"First Portuguese settlement in Cochin, in 1502."—"Haydn's Dictionary."

"A celebrated commander, Almeida, landed in Ceylon, in 1505 A.D., and assisted the Cinghalese against the Arabs, who harassed the island. The Dutch ultimately expelled the Portuguese, and took the town and fortress of Colombo in 1656 A.D. The Dutch took Cochin in 1663."—*Pioneer Mail*, 26 January, 1887.

"Conquest of India by Sultan Baber in 1519–26."—"Haydn's Dictionary."

"The Dutch visit India in 1601; and establish a United E. I. Co. in 1602."—

"French E. I. Co. established in 1664."—"Haydn's Dictionary."

It appears that in the sixteenth century, the Portuguese possessed a number of settlements on the coasts of India, such as Diu (1510 A.D.), S. of Gujerat (this was surprised and plundered by the Muscat Arabs in 1670); Goa (1510 A.D.); Mangalore (1528); (this was the resort of Arabian vessels from early times); Negapatam (1528); (this was taken by the Dutch in 1660, and made the capital of their settlements on the Coromandel coast); Bombay (1530 A.D.); Bassein (1532); Daman, further north (1534). The Portuguese had also factories and influence at Honoré, Canara, Calicut, Quilon, Masulipatam, and St. Thomé Bandel, close to Hughli, they obtained in 1599. Akbar allowed them to build a church in Lahore, and patronized them at Agra, and in his time they also settled in Dacca. So that in the sixteenth century the Portuguese not only almost monopolized the trade all along the coasts of India, but appear to have had great influence in the interior of India also, and the trade of their ships between India, and their possessions in the Malay

archipelago must have been great.—*Pioneer Mail*, 26 January, 1887.

"The Portuguese were the tyrants of the seas, and the terror of the Mecca pilgrims. They seized upon a number of maritime stations; among others Ormuz, Diu, Malacca, and several of the Moluccas, whence they could command the trade of the East. They twice attempted to take Aden, but without success. Goa was their capital; from it they ruled over most of the towns on the Malabar coast. Francis Xavier sailed for the Indies in the same ship as the Viceroy, Martin Alphonse de Sousa. He landed at Goa on the 6th May, 1542. After three years' preaching in India, Xavier sailed for Malacca, from which station he made a number of perilous voyages amongst the Moluccas, and the islands around. The Portuguese had already made some conquests in the Indian archipelago to render more secure the rich trade in spices. At this time Mahomedanism was being spread among some of the islands, half by voluntary conversion, and half by the sword; and some of the chiefs preferred the alternative of being baptised, to submitting to the law of Islam. The islands of Japan, already known to Europe through the travels of Marco Polo, had been reached by the Portuguese only eight years before, and Xavier, while at Malacca, conversed with navigators and traders who had visited that remote coast."—The "Blot on the Brain," by W. W. Ireland.

(*d.*) *The Coptic Church of Egypt.*—"On this divided, and therefore paralyzed religious community, broke, in the seventh century, the great wave of Mahomedan conquest, and in an evil hour for themselves the Coptic Church cast in their lot with the conquerors. The fate of Egypt was decided when the old Roman fortress of Babylon, to the south of modern Cairo, was treacherously betrayed to the Arabs in 638."—*Saturday Review*, 19th Feb. 1887, p. 262.

"The Arabs conquered Spain in 711 A.D."

"Europeans first arrive at Canton in 1517."

"Macao granted to the Portuguese in 1536."

"Moluccas (Amboyna the capital), discovered by the Portuguese about 1511."

"The Dutch conquered them in 1607."

"Java reached by the Portuguese in 1511, and by the Dutch in 1595."

"Philippine Islands discovered by Magellan in 1521."

"Manilla became the capital of the Spanish possessions in the Philippines in 1570."

"First commercial adventure from England in India was in 1591."

"English factories established at Surat in 1612, and Calcutta purchased in 1698."—"Haydn's Dictionary."

No. 40 (A).

An interesting Discovery (*Homeward Mail*, 10th October, 1887, p. 967):—

"Mr. James, the Port Officer of Paumban, was lately on a tour of inspection of the Kilakarai channel. He found the beach strewn with broken pottery, earthenware, china, etc. On inquiry, he found that it was from an old town, which existed there in the time of the Pandyan kings. Coins were often found washed out by the sea, and several were given to Mr. James, some of which are Grecian, Roman, Arab, etc. He sent them to the Collector of Tanjore. According to Bishop Caldwell, Kilakarai is the place where Marco Polo first landed in India."

Supposing that the above is accurate, it confirms what Reinaud said—that Greeks, Romans, and Arabs all traded with India and China. There was, therefore, ample opportunities for disseminating the different kinds of citrus grown in China, and taking them to the different places on the way between China and Egypt and Syria. Those that could be carried furthest would naturally be those that had the thickest skins, such as the citron, the Pomum Adami (shaddock) of Palestine, and the Séville orange. There can hardly be any doubt that in those days the seed was carried in the fruit. It is said the seed will not germinate if removed from the fruit and kept long, but about this we do not know much.

No. 41.

The following are translations from Vol. II. of the "Herb. Amboyn." of Rumphius. They are chapters on the various kinds of citrus he found in the Malayan archipelago, about 200 years ago. I have also translated the Title-page, to show that the work was edited by John Burmann, which may account for some mistakes in the numbers of the plates, and for a few apparent contradictions, and probably typographical errors. Rumphius appears to have been very careful in his descriptions.

Title-page.

The Amboinese Herbarium of George Everhard Rumphius, M.D. Hanavensis, senior merchant, and Consul in Amboyna, celebrated by the name of the Indian Pliny (Plinii Indici), and member of the illustrious Society of the Academy of Natural Curiosities of Germany. It includes many trees, shrubs, herbs, terrestrial and aquatic plants, which are to be found in Amboyna and the adjacent islands, accurately described, according to their forms, with their different names, culture, uses, and virtues. It moreover gives various kinds of insects and animals, many of them depicted with their natural conformation, all collected for many years with great pains and study, and made into twelve books, now for the first time, published in the Latin language, under the care and zealous editorship of John Burmann, M.D., and Professor of Botany in the Garden of Medicine of Amsterdam, and associate of the Cæsarean Academy of Natural Curiosities. The editor has added synonyms and observations of his own.

Part Second.

Amsterdam—Meinard Uytwerf.
M.D.C.C.L.

(*a.*) Chap. 34, p. 96, Vol. ii.
Limo decumanus—Pompelmoes.*

* *Vide* plate 59, figs. A and B.

Dutch—De Pompelmoes Boom.

Malay—Lemon Cassomba (printed Lomen).

"Now we shall narrate of the Lemon cohort, which occur in these aqueous portions of the East Indies; and, at the same time, we shall demonstrate whether and how they differ from those in Europe. First comes before us the largest species of all, the Pomum Assyrium, by the French called Pom-sires, which, on account of its size, we have named Decumanum (huge). Of this we observed four species. The *first* has not a tall trunk, but is thicker than in other lemon trees,* although its branches are more slender; and, therefore, as it produces larger fruit, they are often propped up. Its leaves have the common character of all lemon trees. Their inferior part, however, is cordate,† as if there another leaf had grown. All leaves, at their insertion, have a spine. Those, however, of adult and young trees differ. In the latter the leaves are more than 7 inches long; their inferior cordate part is 2 inches, and the superior part‡ about as broad as the hand; at the edges, almost entire, smooth, and not serrate. If these young trees, however, are situated in shady places, their leaves become a span long, and their width that of six fingers' breadth; and their cordate part has a width and length of three fingers' breadth. The leaflet is rounded at the tip, and emarginate. To every leaf there is a spine, as long as the thumb-joint. The older these trees are, the less spines they have. In adult trees, the leaves are 5, 6, and sometimes 7 inches long, but their cordate parts are smaller and narrower, about the length of one inch, and half a finger's breadth; and in all, certainly as wide as a whole finger's breadth. They are divided by parallel nerves, which in young leaves are prominent below, and in adult leaves above. The old leaves become yellowish beneath, and are downy. As the tree grows older, it has almost no spines, or sometimes slender and short ones, and then only on the young branches.

"The flowers are racemose, and in large white heads, with

* It should be noted that Rumphius uses the word *lemon* generically, nstead of *Citrus*.

† This refers to the *broad-winged petiole* of the pummelo leaf.

‡ The leaflet.

broad concave calices, with 4,* and rarely 5, oblong thick petals, outwardly reflexed. They are somewhat fragile, and easily drop off if touched. Their scent is penetrating, and more exquisite than that of white lilies. . . . The fruit has the shape of an apple, as large as a man's head, round or compressed, but not so flat, as a common cheese. Externally, it has an even surface, excepting here and there a slight eminence ; for the rest, the whole surface is covered with oil cells. Its colour is citrine, but not so shiny and bright as in the citron (malo citrino). It is paler and more elastic (flaccidus). Its skin is more than an inch thick, spongy (fungosus), white, dry, and bitter. It emits a sulphurous† scent.

"The pulp forms a globe, divided into various segments by intermediate pellicles, mostly fifteen or sixteen in number, more or less, arranged as in an orange. This pulp is either red or purplish-red, resembling that of a pomegranate, and juicy, with a vinous‡ or acid flavour ; but in very ripe ones it becomes sweet like currants. In each of the largest segments, there are two or three seeds as long as the joint of the little finger, either smooth or rugose and white. In some of the best fruits, however, there is not even one seed, or perhaps few and small. Such fruits are considered the best. Often three or four of these large fruits hang from one branch at the same time, which bend it down and frequently break it. It has, therefore, to be propped, in order to bear their weight. If, however, only one or two be left on each branch, they then become larger and more juicy.

"Another variety of this *first* large kind is very similar to it, or a little smaller, but with a whitish pulp and an acid or insipid and watery flavour. The latter is also considered more ordinary, as in truth it is more allied to the subsequent *third* species, the one having been given to us for the other.

* Note that this variety is generally 4-*petalled.* Hasskarl says that one of the differences between *Papeda,* and Citrus is that the former has 4 *petals*.

† The rind aroma of all the Citrus Rumphius describes by the word *sulphureus*.

‡ He always uses the word vinous in describing the flavour of Citrus juice. I think he means *sub-acid*, and not, as Gallesio thought, the *colour* of wine.

"The wood is pale, solid, and knotty. It does not crack easily, and when seasoned, is suited to handles of carpenters' tools, more especially the thick roots, which are distinctly striated and veined.

"It flowers in October and in subsequent months, and the fruit ripens in April and May.*

"In Latin it is called *Limo decumanus*, or *malum Assyrium decumanum ;* in Malay, *Lemon Cassomba*,† that is, red lemon, from its meaty colour. Some in Malay call it *Jamboa*, from the Portuguese *Samboa*, which properly denotes the *Pomp-sires*, or *Poma Adami* of the Spaniards, from which, however, these Indian fruits differ much. By the Javanese it is called *Djurru*, or *Djerru*, or *Djerru-Matsjang*, that is *Limo tigrinus*. In Macassar, *Lemon Calucku*, that is *Limo Calapparius*, from the size and form of a *Calappus*.‡ In Belgian, *Pompelmoes*. In Chinese, *Ju*, or *Noay*.

"These trees, in the East Indian regions are not common, and they are considered as having been, at one time, brought from higher regions.§ They are cultivated by amateurs in gardens as much for their fruit as for their shade. They build a wide stone plinth round the trees and tie their larger branches to poles. Those trees, however, which have a limited head and erect branches, and a tall straight trunk, are not considered by them so suited to this mode of training as the lower trees, with a larger and more expanded head. The Amboinese do not enlarge their trees (in this way), and, moreover, the fruit of those growing in their colder mountains is smaller and acid. These trees like a warm soil and a locality in the plains, hence the people of Banda always grow them better than the Amboinese, as the soil there is warmer.

"The fruit is often eaten raw and served with dessert. Its pulp, either alone or with Spanish wine, and prepared with

* In India it flowers in February and March, and ripens in November and December.

† Cassomba is the same as the Indian dye *kussumb*, made from the *Carthamus tinctorius*.

‡ This word may have given origin to the Bengali variety called *calamba*, or *kalama*, meaning, in Javanese, cocoa-nut. (*Calappa*, Rumph. vol. i. pl. I.)

§ Probably more *northerly* regions is meant.

sugar, becomes a pleasant refrigerant on hot days. The addition of wine is made so that the fruit may not produce griping so easily. If this fruit be cut, it is important that neither the knife which penetrated the bitter skin, nor the hands which peeled it should touch the pulp, because this then acquires a bitter taste. And hence, in order to open this fruit properly, it should be cut by removing a slice from the top and bottom like a pie-crust, and about an inch thick; when the red pulp appears it can be got at better; by this way the remaining portion of the skin can be removed carefully by a knife without spoiling the pulp. This fruit is capital for sea voyages, as it can be kept for a long time without spoiling, if gently handled, and taken from the tree carefully, and not allowed to fall on the ground. It should be hung up in the ship by means of strings, so that it may be eaten during the voyage. It invigorates the stomach and quenches thirst.

"The *second* species occurs in Banda, and agrees in foliage with the common one, but it has a taller trunk and erect branches. Its leaves are rounder and more serrate at the edges. The inferior part is cordate, like that of *Lemon Itam*, or perhaps a little larger. At their insertion the leaves have a slender and short spine, not in all, however, and the spines are not of any particular form. Its leaves are in their totality about 7 inches long; the inferior part 1½ or 2 inches long, and the superior part (leaflet) about 4 fingers wide, and thicker than in the common kind, nor are the lateral nerves so prominent. They are more acuminate and equally emarginate. Others, at the tip, are irregular, sinuous, and with excavated edges, as if they were going to form another cordate part, which in many is 3 digits wide; in others, however, scarcely one.

"The fruit (of this *second* species) is smaller, not globose but pyriform, resembling large winter apples, and if ripe, becomes thicker round the stalk, hence it looks gibbous. It is about ½ a foot long, and certainly 5 inches across. Unripe it is of a grass green, and becomes citrine as it ripens. The pulp is redder than in the common one, and has a hollow centre. It rarely has seeds, indeed, some are wholly seedless. The flavour is subacid (vinosus). This species rarely occurs

in Amboyna, more frequently, however, in Banda, hence by some it is called Bandanese.

"The *third* species of this tree bears fruit of the size of the globe or ball, which is used in the game . . . .? (lusui conorum). Round the stalk it is equally gibbous. Its skin is neither very thick nor bitter, but it is hardly edible. Its pulp is white, very juicy, acidulous, and in the ripe fruit sweeter, as in the *Limo Martinjo*. It bears smaller leaves than the preceding, and almost resembling the leaves of this *Limo Martinjo*, but they are stiffer and smoother (more glabrous). Their cordate part is of the size of that of *Limo Itam* (Séville orange), and at their insertion here and there are short and not frequent spines. The trunk is taller than that of the common kind, and has many erect branches, like *Limo Martinjo*, but its head is larger. This variety is rare in Amboyna, and is there called Japanese, as it was first brought from there. It is not, however, held in great estimation, because its fruit is neither acid nor sweet, and is mostly used for a rustic drink called 'Pons' (Punch ?), which is made of water, arack, citrus-juice, sugar, and several aromatic ingredients mixed with it one after the other.

"The *fourth* species is rarest of all. Its leaves are like those of the first variety, but smoother (more glabrous), and at the edges not serrate, and rounded at the tip, where they have a short apex, or are bifid (emarginate). Beneath they are not downy,* as in the common kind. Its fruit is largest of all, equally elevated (round the stalk), irregular and tubercled. Five or six hang from one stalk, and are covered with foveoli. The colour resembles that of other kinds. The skin is more than an inch thick, bitter and sulphurous. As to the rest, its scent and flavour are like those of others. The pulp is white, more juicy and sweet than in the common ones. It has hardly any seeds. In this kind there seldom are any. When peeled, it is of the size of an orange, which, in its pulp is larger than others. It is subdivided by a thin and pithy pellicle. Some smaller ones, in their upper part (apex), bear a new layer of rind ; others, within this, have a small pummelo of the same substance, colour, and flavour, as the

* Note that Rumphius knew of a variety of pummelo which had *not* downy leaves.

rest of the pulp. This, however, does not occur in all, but only in a small number of the fruit of this kind of tree, and this phenomenon is mostly met with in those from Banda, whence this fruit was brought to Amboyna. The seeds of such fruit, sown in the latter place, readily germinate, and produce strong and perfect fruit, but they very rarely contain a second pummelo.

"In Batavia, there are pummelos also with a white pulp, but the red ones are preferred. None, however, there produce a double fruit, unless they were propagated by seeds from those of Banda, where the finest grow in Plo-ay. In truth they are most difficult to propagate, as in these, seeds rarely occur.*

"This species (last or fourth), is called *Limo Prægnans* (gravid or swollen). In Malay, *Lemon Bonting*, and also *Lemon Banda.* See 'Chinese Atlas' p. 131, in which the following occurs: 'The proper native country of these trees and fruits is said to be the twelfth, and principally the Southern Chinese province *Quantong* (Canton), there called "*Yeucu;*" but by the Portuguese it is called *Jamboa*,† which is the same as *Zamboa*.'

"The fruit of these exceeds in size a man's head. Their pulp is red, juicy, and acidulous, resembling half ripe grapes, and if hung in the house, they will keep good for a year. The leaves of young trees, crushed between the hands, give a very grateful odour, which almost resembles that of scented *nails or hands.*

Observations by the Editor.

"These trees and their fruit, described by Rumphius, are rather varieties than peculiar species; by variation in the mode of growth, and in their soil, and by different modes of culture, from one species, so many have resulted. This tree is called *Malus Aurantia Indica*, with the largest fruit of all,

* From this it is clear that in those days the art of grafting and budding was not known in the Malay archipelago; indeed, in another place Rumphius says so. The art of bruising the bark, and surrounding it with clay, to induce the formation of roots, as in layering, *was* known.

† In Ceylon the pummelo is called *jambole*, and they have also an orange called *jamboo-nárun.* Probably these names are derived from *Jamboa.*

called *Pumpelmus*, with a pale or reddish pulp. (See Herm. in H. L. Bat., page 405.) Moreover, a branch of this tree, with fruit elegantly drawn, and by a figure expressed, is to be found in 'Merian. Insect. Surinam,' at page 29, where also see notes; also 'Thesaur. nostrum Zeyl.,' page 39, where also find many of its synonyms and authors.

"This is also that tree which is supposed by botanists to be the *tree of knowledge*, the fruit of which, in the terrestrial paradise, was forbidden to our first parents, hence, also it is called *Pomum Adami* 'a Casp. and Joh. Bauhino.' By one of these names it is also known by 'Pluknetii Mantissa, and Amaltheo, l. c., in Thesauro Zeyl., &c.' This tree is mentioned also by 'Valent in Amboinæ descript., p. 188.'"

(*Nota bene.*—It is evident that in the days of Rumphius pummelos were used in sea voyages, and as they kept long they could have been easily taken all along the eastern coast of the Bay of Bengal, and also to India and Ceylon, where their seeds might have been easily sown. It appears, however, that in those days there was a tradition that the pummelo came to the Malay archipelago from the south of China. In the days of Rumphius, more than 200 years ago, there were many Chinese residents in that group of islands, and, as he says in another place that the art of budding and grafting was not known in those islands, it may be inferred that in China in those days this art was not known either. Possibly this art may have had its origin in Europe, and was thence transported to the East.—E. B.)

(*b.*) Chap. 35, p. 99, vol. ii.

Malum Citrium.

Lemon Sussu.

Dutch, Citroen, Boom.*

"In India (Dutch India) the citron trees do not grow into trees, but only bushes, with long and drooping branches like whips, so as to touch the grass. The leaves differ from those of all kinds of lemon trees.

"They are not cordate (that is they have no wings to their petioles), and larger than laurel leaves. They are oblong and subrotund at both ends. The edges are mostly serrate. They are also of a more pleasant green than those of other

* *Vide* plate 141, figs. A and B.

lemons ;* four or five inches long ; two inches broad ; and their edges inwardly inclined. They have short spines in young trees at the insertion of the leaves, and long ones in the old trees ; white† flowers, larger than in other species, with five long and thick petals, with feeble scent. . . . . The fruit is of two forms, which, for the sake of distinction, I divide into *wild* and *cultivated.* The wild form is very common, with a shape like that of the Spanish lemon,‡ but a little larger ; oblong, broad towards the stalk, and ending in a mammilla. Here and there its skin has warts ; the rest, however, is smooth and yellow. Its fruit is about five inches long and four broad. Near the stalk it is tubercular and uneven. The skin is nearly of a finger's thickness ; fungous without any sulphurous scent like other lemons ; but insipid, and scarcely edible. The pulp is very small, and hardly occupies half the fruit ; it is white, juicy, and acid, as in others ; but not so pleasant. Hence, it is used as a condiment only when others are not procurable.

"The fruit of the cultivated variety is double the size of the foregoing, resembling a melon about a foot long, and six inches across. Some, indeed, are a little smaller and more warty than the wild one, and also terminate in a mammilla. The colour is not citrine but pale, and approaching more to green. Its skin is an inch thick. The pulp, however, is like that of the wild one, but its flavour is more vinous, and its skin more juicy and harder than that of the wild one, and very good for preserving.

"In Latin it is called *Malum Citrium.* In Malay *Lemon Sussu,* that is *Limo mammosus* (like a mamma). In Belgian *Citroenen.* In Portuguese *Cidra.* In Amboynese, in 'Hitoëa,' *Ussu wale,* that is *Limo repens,* resembling a rope, on account of the long and flaccid branches. In Banda *Usse Ala,* that is *Lemon Bras,* or *Limo orizarius.*"

"It is well (Rumphius goes on to say) here to mention a philological discourse on the origin of the word Citrus—by

* It is well to remember that Rumphius uses the generic name of lemons for *all* kinds of *Citrus.*

† Here are citron trees with *white* flowers, instead of *purplish.*

‡ It is evident that in the days of Rumphius a lemon—probably the same as the modern Sicilian and Malta lemon, and that of the London shops—was already known over Europe as the "Spanish lemon."

Bauhin—libr. 1, cap. 25, where he comes to the conclusion that the *Etzadar* in the Sacred Scripture means this fruit, that is, a branch of a particular tree, which the Israelites used to carry about in the feast of the Tabernacles. Hence the Chaldean name of these fruits—*Extrogin*—in the singular *Etog* and *Etrog;* and hence also the Arabic *Atrog*, from which perhaps the Greeks made κίτζος. The German Jews moreover about the 8th September, in the festival of the Tabernacles, still assemble to beg them from . . . . ? (Marsilia), because they think no fruit more handsome than this Citrus. This is therefore the *Malum medicum* of Dioscorides; *medicum and persicum* of Theophrastus; κίτζος, or *Malum aureum* of the Greeks; *Assyricum* of the Athenians; *Hespericum* of Pliny, and the ancients. It is different however from the Citrus (*Cedrus*) of the ancients, about which see libr. 3, cap. de Lingoo, and at its end.

"This tree is not frequent in these islands, and therefore its use is rare. Here and there, the one or the other variety grows in some plot near habitations. In Banda, it is more frequent, partly in forests, and partly in abandoned gardens, where they had been planted instead of hedges. In Banda, a large species is cultivated in gardens, whence also it came to Amboyna, but in the latter island, it is not so fruitful as in Banda. These Citrons are more plentiful in Java, and mostly on woodlands, as they are also in the Brazils. Everywhere however it is a shrub, and not a tree.

"The thick skins of both kinds are preserved in sugar, but mostly those of the cultivated kind are used. For such a purpose, the outer rind should be scraped off, and then the thick skin should be steeped in water for some days, and then boiled in sugar. Some however are candied, and served as dessert. This is done mostly by Chinese and Europeans, as the Indians are ignorant of this art, and they only make use of its juice as a sauce.

"A certain variety in Javanese is called *Lemon Java*, that is *Limo Javanus*, because there it is supposed to be indigenous.

"There is yet another kind, which grows slightly taller than the preceding ones. Its leaves are similar, but perhaps a little larger, more acute, with finely serrated edges, and everywhere with many long and sharp spines, so that it can

hardly be handled. The flowers of this are smaller, the fruit oblong, rotund, and of the form and size of the Spanish lemon. At its extremity it has also a mammilla, and externally it is smooth. The skin of this is very thin ; the pulp moreover is more plentiful, more juicy, and more acid than in the former ones.* This kind however is rare in Amboina, and has been brought there from Banda. It is not used for other purposes than as an acid sauce or condiment, like other lemons.

"Certainly a sweet and very pleasant citron † of a superior variety has been propagated by cultivation, the pulp and the skin of which are both edible. Moreover it has an elegant yellow colour when ripe.

"All these trees, as is also stated by other authors, differ from the Citrus (*Cedrus*) of the ancients, which grows in Mauritania, on Mount Atlas, and which is a species of Oxycedrus, with leaves, fruit, and scent very similar to those of the Cypress. As is stated by Pliny, libr. 3, cap. 15, out of the wood of the latter, in ancient times, were made fine tables, called *Mensae Citreae* and *Citrinae*, on which, along with various figures and marks, could be traced imaginary tigers, panthers, and leopards."

(*c.*) Chap. 36, p. 101, vol. ii.

Limo Tuberosus (fig. 2, Tab. 26)—(in Rumph. it is fig. 1, E. B.)

Lemon Martin.

"Among the species of acid lemons, which in all India are as plentiful as the sweet ones, the most noted for size, are those having many tubercles. Of these, the largest is called by the people *lemon martin*. When full grown, this tree is about the size of a common apple tree, but its branches are very crooked, as well as its trunk. The leaves are very like those of the citron.‡ (*Vide* pl. 141, fig. *a* of the Atlas.) They are however shorter and not very cordate, so that their petioles appear only slightly winged. In the younger leaves this cordate shape is more apparent. At their edges they are equally serrate, and if roughly rubbed, they have by no

* In this variety, it would appear, we have an approach to the *lemon* proper.

† This is like the madhkakree of India.

‡ Evidently Rumphius is here describing *fig.* 2 of Table 26, and not *fig.* 1 of his illustrations.

means an unpleasant scent; moreover they are not bitter. They are three or four inches long; in the younger branches near the leaves, there are small and weak spines, but in the old branches, when the leaves have dropped off, they are larger and more acute, and so cover the branches that they can be scarcely handled. In still older branches however, they become less frequent, so that they are as rare as in the small branches.

"All flowers of lemons * first form white heads, and from these small flowers grow, consisting mostly of five, and more rarely of four white thick petals. On the contrary, in this species they are larger than in the common kinds, and formed of five petals, with their exterior purplish. The fruits are not uniform. Some are certainly as large as two fists, somewhat pyriform, or resembling a quince, and round the stalk almost covered with large tubercles, the remaining portion having smaller tubercles, resembling warts. Other fruits, on the contrary are oblong, oviform, or acuminate at both ends, and covered all over with depressed tubercles, or larger warts. When ripe, these lemons from green turn yellowish, and sometimes they are yellow or citrine, almost like the colour of Spanish lemons. The skin is tolerably thick, and if peeled, it emits a sulphurous spray, which is oily. The scent is grateful, and quite citrine, so is its flavour; at the same time it is bitter, and pungent to the tongue. The pulp resembles that of the European lemon, and is acid, but feebler than in any other species, and therefore it is also eaten raw, but as a condiment others are preferred. This tree gives fruit almost all the year round. At the same time it bears flowers, half-ripe, and fully ripe lemons. It requires however to be carefully pruned, as more than others it gives many erect and spiny branches, which enfeeble it. This we have also observed in others.

"In Latin it is called *Limo tuberosus Martinicus*. It should certainly be noted that all the Indian species of lemon are called by the Malays by the general term of *Lemoen*, while in Europe this name is given to only *one* species. This tree moreover is called *Lemon Martin* by the Malays. How it

* By lemons the author probably means Citrus, including oranges, pummelos, &c.

got this name, however, is quite unknown to me, but it seems likely that it may have first come into notice through a Portuguese of the name of Martin, and hence its name. As these kinds of fruit were not accurately described by the old authors, they were given the general name of *Mali Citrii*, *Medici*, or *Hesperici;* in subsequent times however their species were more carefully studied, and one was called in Latin *Limonium;* and in Pharmacopœias, *Limonem*. This last we have retained, as, properly speaking, *Limonium* is a herb. In vain may any one search for the derivation of this name in European languages. The Arabic word is *Leytun;* the Persian *Limum*, which least of all approach *Malum medicum*. Similarly *Torong*, and *Toronga;* although this is a larger kind, and which the Arabs call *Altrung*, and *Ottrog;* although properly speaking *Torong* is Persian. From this, the Spanish *Toronja* has come, by which is understood a citrus larger than the one under discussion, and which has a sweeter skin, and is of the size of a melon, such as is described in the preceding chapter. In some respects, however, our *Martin* resembles it very much. Among the Amboynese and adjacent people the *Lemon Martin* has no special name, as to them it is mostly unknown. Generally however, they call all lemons *Aussi* and *Ussi*, while among the Malays, they go by the name of *Lemon;* in Ternaté, *Djodji;* in Macassar, *Lemo;* in Java, *Jeroc;* in Baleya, *Djoboc;* in Banda, *Usse;* and the Chinese give them the general name of *Cam*.

"In these Eastern islands the *Limo Martin* is indeed to be found everywhere, but nowhere does it grow spontaneously, or among the natives of Amboyna, but only among Europeans; from which circumstance I infer that it has been brought from elsewhere, especially by the Portuguese, who, perhaps, may have brought it to the East Indies from the West Indies. Of all acid lemons, its pulp is the most vinous, hence divided into quarters and sprinkled with sugar it is eaten raw. It is very refrigerant and acts as a laxative in sea voyages. If, however, it be eaten in this way, the white exterior skin should not be wholly removed, as this tasteless substance tempers the acidity of the other. Its skin is edible, if the outer rind be shaved off. The juice of this lemon is also

used in a drink called *Bœrepons,* for preparing which it is better than that of other lemons, because less acid and does not cause griping. The peel of this lemon, moreover, contains an aromatic spirit (the essential oil) ; however, on land it is seldom used, except when cooked with fish or meat, the flavour of which it improves. This lemon is also used for washing the head, but mostly for want of other kinds. Its raw pulp, eaten with sugar, loosens and expels the phlegm, which gathers in the lungs, and which often causes an oppressive asthma and a convulsive cough.

"Again, this tree does not grow to a great age, unless it be carefully pruned and cultivated. It easily engenders certain larvæ and then exudes a lot of sap and copious gum, after which it wastes away and perishes. It sometimes happens that half the trunk and a portion of the head dies. The other half then, to some extent, gives meagre fruit." (*Vide* pl. 129, fig. *a.*)

(*Nota bene.*—In the original, either Rumphius or his editor, Burmann, must have made some mistake, as in the "explicatio" of tab. 26, fig. 1 is called *Limo tuberosus,* but the above description evidently refers to *fig.* 2 (called in the explanation *Limo ventricosus*), so in the plates of my Atlas—No. 129 fig. *a*—is the one with which the description of *Limo tuberosus Martenicus* tallies.—E. B.)

(*d*) Chap. 36, bottom of page 102, vol. ii.

"*Lemon Purrut.*—Besides the Lemon Martin above described there are other warty species, as we shall presently describe, of which first is *Limo ventricosus* (fig. 1, tab. 26),* called *Lemon Purrut* by the Malays. The tree of this grows to the size of the foregoing, but has a thicker and narrower head ; it has also many erect branches. In foliage, however, it differs much from the foregoing (*Lemon Martin,* fig. 2). Its leaves are about 4 inches long, and the inferior part is so cordate and large as to constitute almost half of the whole leaf, and so erect as to seem two leaves—one placed over the other†

* In Rumph. it is fig. 2.

† The reader is requested to note this, and compare it with figs. *d* and *e,* pl. 225 of my Atlas ; and also with the leaf of C. hystrix, described in Kurz's Flor. of Br. Burma. By inferior or cordate part, Rumphius means the *winged petiole.*

(inferior ejus pars cordata tanta et tam ampla est, ut fere dimidiam totius folii constituat partem, itaque erecta, acsi bina sibi essent imposita folia). At the edges, however, it is slightly serrate, thicker, and of a darker green than in the foregoing. Its flower is, of all, the smallest, consisting of four petals, and when open hardly as big as the nail of the little finger. Its fruit is half the size of the *lemon martin*, hardly equalling that of one's fist, and pyriform, but so covered with tubercles (sed ita tuberculis obsitus) that it hardly has the same shape (as the *Lemon Martin*). Its tubercles, however, separately observed, are smoother than those of *Lemon Martin*. Mostly it is green, and when wholly ripe slightly yellow. Its skin is more solid and juicy than the foregoing. Its scent is pleasanter than in any other Indian lemon, and better than that of the Spanish lemons, or equal to them. The pulp is greenish, granulose, and very acid, with a certain sharpness, as if it were corrosive. It is not very juicy, but contains many seeds. The branches are covered with sparse small spines; they are, however, more frequent than in *Limo Martin*. In truth, long spines in this tree rarely occur, hence it can more easily be climbed than the foregoing.

"In Latin it is called *Limo ventricosus*, in Malay *Lemon Purrut*, on account of its numerous tubercles, which, like warts, cover its whole surface; some also call it *Lemon Papua*, that is *Limo crispus*, from the form of curly hair which the Papuans have; others then call it *Lemon tay Ayam*, that is, comparing it to fowl's dung, from its shape, which it resembles, as if a lump of earth had been hardened by means of fowl's dung; in Ternaté it is called *Djuru purrut*.

"It occurs in Celebes, and almost in all the islands of Amboyna, as also in Banda. Everywhere, however, it is not common, but rare. It is the skins of these lemons that are most used. The rind is scraped off and mixed with a little water, and thus they serve for scrubbing the head after it has been previously washed and cleaned by other means, and the dirt removed. It then produces a nice smell in the hair.

"The acid juice is rarely used in food, but mostly for the preparation of paints, for which purpose the most acid lemons are selected. Some also wash their head and body with this

juice, but for this it is not suited, as its sharpness wears away the skin, especially if the sun shine upon it, and then the roots of the hairs become loosened and are destroyed. The fresh skin is also cooked with the gravy of meats, and it can also be preserved in sugar as well as that of Lemon Martin, but this is rarely done." (*Vide* pl. 226, fig. *a*.)

(*Nota bene.*—In tab. 26 of Rumphius's book there are three figures. Burmann, in the explanation of this plate, states that fig. 3 (pl. 227, fig. *a* of my Atlas) is *Limo ferus*. Now its foliage does *not* agree with that of *Limo ferus* (pl. 226, fig. *c* of Atlas), but is identical with that of No. 1—*Limo ventricosus, Lemon Purrut*. I look upon it as a smooth fruit form of the latter. (*Vide* pl. 27, figs. *a* and *b*.) These are a smooth and a warty form of the *khatta* orange of India—both taken by myself from the same branch of the same tree in Benares. The smooth form is the regular crop, and the warty is the *Dumrêz* crop. As fig. 1 and fig. 3 of tab. 26 of Rumphius' vol. ii., have identical foliage, it is more reasonable to look upon them as the smooth and warty form of the same *Limo ventricosus, lemon Purrut*, especially as the foliage of both differs much from that of *Limo ferus*. Variations in the exterior of many Citrus are very common.)

(*e*) Chap. 36 (last part), p. 103, vol. ii.

"The *third* species of warty lemons is *Limo curamas*, which has smaller leaves than the preceding (*Lemon Purrut*); otherwise they are similar, and especially with regard to their being made up of two pieces. They almost resemble those of *Limo Maas*, but their cordate part is larger. The fruit, however, is like that of *Limo Martin*, both as regards size and shape. This also is so irregularly round and shapeless, covered over with tubercles and fissures, as to prevent any decided form being assigned to it. Many, however, are longer than broad, and contracted round the stalk. Many have a dark green colour, inelegant, or from dark become green; at length, however, in some, yellowish spots appear. They afterwards become rugose, and on all sides covered with tubercles, but these are not so pronounced as in *Lemon Purrut*.

"The pulp is white and dry, consisting of many granules, like pedicles; nor is it so juicy as *Lemon Martin*, and, if

allowed to become fully mature, is indeed dry, and gives little juice, quite acid. The scent of the skin is strong, and not so pleasant as in *Lemon Purrut*—nay, it has a goatish smell, and the leaves give off a similar scent.

"The seeds are oblong, slender, thin, and rugose; at one end, indeed, they have almost a tail, composed of several veins, which adhere to the intermediate pellicle. The branches are everywhere covered with spines, which, in the larger branches, become very small.

"In Latin it is called *Limo unguentarius*, and by the Malays *Lemo curamas*, from a scented ointment, with which the body is rubbed, and in which the pounded rind of this lemon enters as one of the ingredients.

"In Amboina it grows in gardens in wild places,* and several are planted in villages, but these trees are little known.

"Of this kind nothing but the skin is used, which is mixed with this ointment. Some then rub the head with it, after using the lotion, mentioned under *Lemon Purrut.* This scent, however, is little liked by persons of our nation, as it is not pleasant, for which reason also it is not highly prized by the inhabitants. Some, however, prefer it, and with greater effect use its cut up pulp, steeped in water, with which they wash the head. It removes the dirt and scruff very well."

(*Nota bene.*—In Ceylon the *lima*, which the foregoing *Limo ventricosus* closely resembles, has an acrid rind, and an unpleasant flavour in its pulp. The Cingalese do not use it in food, but only for washing the head. The plantation coolies also smear it over their feet and legs, to keep off land leeches; and therefore in Ceylon it has got also the name of *Kŭdalu dèhi*, or Leech Lime. Europeans call it Caffre Lime.)

(*f*) Chap. 37, p. 104, vol. ii.

"*Limo agrestis.*

"*Lemon papeda.*

* Alf. de Candolle in his "Origin of Cultivated Plants," p. 180, translates "in hortis sylvestribus," into "shrubberies." I think what Rumphius means is "gardens in wild places," such as are to be met with also in Ceylon, in the midst of forests, and surrounding a few huts of wood-cutters, &c. The above description also agrees with that of the *lima* of Ceylon, which is often found in similar places.

"Dutch—Wilde Pap-Lemoen.

"This especially is an indigenous tree of these islands, and more common than all the foregoing. It grows taller than they, and has a crooked trunk and irregular and wild-like branches. The small branches, at the leaf stalks, have everywhere sharp and hard spines, so that this tree looks more horrid and spinous than all the other species of lemons ; and hence it does not admit of anyone climbing it. The leaves appear as if formed of two leaves, but the inferior cordate part is much smaller than the other superior portion (the leaflet), and is tolerably broad. Both together are about 4 or 5 inches long, and there are no leaves without spines. At the edges the leaves are only slightly serrate. Their oil cells are so large that they appear perforated, and the air can be seen through them.

"The fruit comes up to the size of *Lemon Martin*, but is not so pyriform, more round, smoother, and of a more solid feel. Here and there it has smooth tubercles, so that it cannot be called altogether spherical, but irregular and oblique. The colour is very yellow and even, and it is not foveolate. The pulp is totally white and juicy, and very sharply acid, so much so, that alone its juice is not used in food, but is mixed with some other juice. The scent of the rind is citrine, but not so grateful as in the foregoing kinds. The wood is solid, hard, and yellowish, resembling box-wood. The roots of old trunks are yellower, and, at the same time, striated.

"These lemon trees like wild gardens, and their nature is more wild than that of other lemon trees. The Amboynese exhibit no care in cultivating and pruning them ; nevertheless, they hold them in greater estimation than our nation do, and they are to be found near all their villages.

"In Latin it is called *Limo agrestis*, because it loves the fields, and likes wild places more than all other kinds. It is also called *Limo pultarius ;* by the Malays, *Lemon Papeda ;* in Macassar, *Paralli ;* in Amboyna, *Ussi Lapia ;* in Ternaté, *Lemo Jabba*, that is, the Amboynese lemon. It is found in almost all the East Indian islands, from Celebes to Amboyna, In Saleyera its fruit is largest and best. Certainly in Java and Baleya it is unknown.

"The skins of these lemons are in no way used, but the

pulp is in daily use as a condiment and pickle, in a porridge or pap, by them called *Papeda*. Every mouthful of this is dipped in the juice, and then eaten. From this custom its name may have arisen. Always, however, some fish or meat broth is added, as otherwise it causes some griping, for which reason our nation do not use its juice much, but prefer other milder lemons. It is also used for preparing the fine pigment called *Cassomba*, from the dry flowers of the Carthamus,* or *Cnicus* flowers, for the preparation of which always the most sharply acid lemons are required, as is clear from the description of its preparation. For this reason, the inhabitants of Saleyera take for sale to Macassar this kind of fruit in greater quantity, since there the largest part of the *Cassomba* pigment is prepared and consumed.

"The roots of the old trees are largely used by the people of Macassar for making handles of large knives, and of the weapons called *Krissen*,† made by them, since this wood is solid and streaked.

"Some of the Amboynese take a certain quantity of the juice of these lemons, and heat it on the fire in a pan, until half the quantity has evaporated, and the remainder has turned blackish. With this the Amboynese smear smallpox, so that it may suppurate and dry quickly. This cure, however, few can tolerate, as it smarts excessively.

"Another variety of this species is called *Lemon Carbu*, the fruit of which, of all acid lemons, is the largest. Its tree is higher than others, with many branches, and an extensive head. Its leaves are like those of the foregoing (*Limo agrestis*), but mostly they are larger — 5 inches long and more. In the upper part (leaflet) more serrate, in the lower or cordate part, it is smaller than the other by half, but as broad. Hence these leaves also appear double. It has smaller spines than the other kind (*Limo agrestis*). The flowers are the same. The fruit is about the size of a child's head, some even larger than a man's head, not really round or spherical, but pyriform, rather irregular, and covered with large tubercles resembling those of *Lemon Papeda*. The rest is smooth, nor has it any foveoli: and when ripe it be-

* Safflower, or "kussumb," of the natives of continental India.

† *Vide* Appendix, No. 66.

comes yellow all over. Its skin is not thick, but solid, and with a strong, but unpleasant scent, resembling 'aquam fortem.' * The pulp is white, very acid and sharp, so that, owing to its excessive acidity, it is not used in food. Its strong scent produces giddiness, and does harm to the head.

"In Latin, it is called *Limo Taurinus;* among Malays *Lemon Carbou.* The Malays, indeed, to all large things apply the name of Bull or Elephant, in the same way that the Greeks express large size by the preposition of the particle *Bu.* Hence, it would not be out of place to call this fruit "Bulimonem." In Macassar it is called *Lemon Cambar,* that is a tumid or swollen lemon; in Amboyna *Usse Ela Bal,* or *Djoboc Carboo.* In Ternaté *Lemo-Cabi,* that is goatish-lemon, from its offensive smell.

"In Amboyna it rarely occurs, but more frequently in Macassar, and many there plant it on plots near habitations, on account of its shade.

"The juice of these lemons is mostly used for cleaning weapons, both of brass and iron, when they become rusty; hence, some called them *Lemon Padangh,* that is weapon lemons. If the Malays and Macassarese clean their swords and weapons either with the juice of this, or with any other thing whatever, they are afterwards in the habit of giving them a blue tint. This can be done as well by the juice of these lemons as by that of *Lemon nipis,* if corrosive sublimate (sublimatus mercurius) be added to it, and which is called by them *Warangau.* By this composition the weapons are preserved from rust, but at the same time it poisons them. Certainly lemons are very useful for cleaning and brightening all sorts of copper things, either with their juice alone or mixed with charcoal, and afterwards freely washed in water and dried in the sun.

"It can also be used in preparing *Cassomba.* They may, however, prefer other lemons for this, as they obliterate more effectually the smell of dyed clothes than this taurine variety. Both these fruits here described, however, become covered with a soft gummy secretion. These and other acid lemons are used by the people of Macassar for washing their clothes, for which purpose they take a larger proportion of juice than

* By "aquam fortem" Rumphius probably meant *alcohol.*

water. This, however, is chiefly done with the clothes of royal people, because, when these are so washed, they both better absorb and retain the odour of Musk and Zibeth, and similar odours."

Observation.

It may be also noted that *Lemon Papeda* and *Lemon Carbou*, or *Limo Bubalinus*—" a Valent. in Amboinæ descript., pag. 189"—are also mentioned. (*Vide* pl. 226, fig. *b* of Atlas.)

(*g*) Chap. 38, p. 106, vol. ii.

" *Limo ferus.*

" *Lemon swangy.*

" Dutch—Wilde Lemoen Boom.

" This species of lemon is also indigenous, or Indian, and of a wild nature. The tree is not very thick, and smaller compared with the others. Its head is small and its branches are straight. The leaves are like those of *Limo Papeda*, but rather longer and more acute; about six inches long and more; the anterior part slightly serrated. In its middle, however, between the cordate and superior part of the leaf there is a bend, and the leaves are slightly inflexed. The fruit is smaller than that of all preceding ones, similar to the Spanish lemon, but smaller and tapering at both ends. Some are pyriform; others are like the larger plums, oviform, everywhere covered with warts; dark green and slowly becoming yellowish, which colour is mostly observed in those which grow near buildings and are there cultivated. The pulp is small and granular, but juicy and very acid, producing griping. The scent is not unpleasant, citrine, but feeble, and mostly wild-like. The branches also bear long spines, but small ones on the twigs, near the leaves.

" In Latin it is called *Limo ferus*; in Malay *Limoen Swangi*, from its irregular and deformed shape. The Malays, however, give the name of *Swangi* to such things as belong to the forest, are wild, and of irregular form, such as are mostly magicians and chiefs, whom they properly call *Swangi.* In Amboyna it is called *Usse Maluměit*, and *Aussi Wolu.* In Ternaté, however, *Limo Titigela.*

" In Amboyna it is mostly found in out of the way village gardens, and near their buildings.

"Its juice is rarely used, excepting such as the Amboynese use with their *Papeda* porridge, but mostly for the preparation of the *Cassomba* pigment. Then its skin and juice is cooked up with other medicines to enhance their power, especially with bitter potions, which are given to clear the body and correct bad humours. With its rind the head is rubbed after washing it, as has been stated of *Lemon Purrut*, but care should be taken that the juice neither touch the skin, nor drop on the body."

Observation.

Under the name of *Lemon Swangi* it occurs in Valent. Amboinæ descript., p. 190.—(*Vide* pl. 226, fig. *c* of Atlas.)

(*h*) Chap. 39, p. 107, vol. ii.

"*Limonellus.*

"*Limon nipis.*

"Dutch—Liemis Boom.

"Of all the acid lemons this is the most common and most used (vulgatissimus et usitatissimus). Its trunk is more slender than that of the foregoing (*Lemon Swangy*); scarcely thicker than one's leg; mostly crooked and bent, having only few branches, which are crooked and spread out, and which bear numerous very short and spiny branchlets, the whole forming an extended and irregular head. The leaves are smaller than in any foregoing ones; about three inches long, with a small but very distinct cordate part, or winged petiole ('parva, sed notabili cordata parte'; according to picture about $\frac{1}{7}$th of the whole leaf). At the edges they are slightly serrated and of a much pleasanter green than other lemon leaves. The spines which are long and slender are firmly joined to the leaf insertions. The flowers are similar to those of the foregoing with five whitish oblong petals (his picture, however, shows only four petals), turned outwards, gathered together, and exhaling in the morning a grateful odour like those of *Lemon Martin.* The fruit is much smaller than the preceding: of the size of an apricot, globular, without tubercles, but some instead have a marked furrow, and mostly near the stalk, or in the inferior extremity (apex), with a few tubercles resembling warts. At first the fruit is green and then citrine colour. Its skin is very

thin (*kaghzi*) and has not a greater thickness than the stalk. The interior is full of pulp, white or greenish, and very juicy; pleasantly acid, and has a nice odour and flavour. Its pulp and skin are almost like those of the Spanish lemon. The seeds are whitish, round, and oblong, and germinate readily if they fall on the ground, or are sown in it. Some of these fruits increase in size to those which in Europe are called *Malum Orthomasticum* (a variety of apple) which has a pleasant smell, when rubbed or held in the hand. If, however, these trees are not properly cultivated they produce small and warty fruit, which take a long time to turn yellow, and become covered with a gum-like secretion.

"This tree does not like a rich and fertile soil, but a hard one, mixed with stones and old rubbish of decayed buildings (demolition mortar?). In such a soil it grows finer and luxuriates more. Sites, which are well exposed to the sun, suit it better.

"In Latin it is called *Limonellus*, or *Limo tenuis*. In Malay *Lemon nipis*, on account of its thin skin; in Ternaté, *Lemo Java;* in Amboyna, *Aussi Pipis;* in Macassar, *Lemo Capas*, as it is not much larger than a cotton-pod;* in Banda, *Ussecrawo;* in Baleyera, *Djoboi;* in Chinese, it is called *Suyn Cam*, which is the general name of the whole of the acid lemons.

"It is found from Java to all the East Indian Islands, not in the forests, but everywhere near habitations, planted and carefully cultivated. Moreover it fruits all the year round, but at one season it bears more plentifully than at others.

"The juice of these lemons is in daily use; by it every kind of food is acidified, as all the people of India (Dutch India) vastly prefer lemon-juice in their food to vinegar, the lettuce excepted. This juice, used with food, tastes very nicely and is delicious. In the green state its skin is preserved in sugar, and the whole fruit is pickled in brine, to have it at hand all the year round. This pickle is made as follows: fresh limes are slightly scraped, to remove the green exterior; then they are pricked all over with a sharp pointed bit of wood, so that they may be covered with holes. Then for three or four

* *Capas* is another word common to India, meaning cotton.

days they are steeped in pure water, to rid them of their bitterness; afterwards they are slightly dried in the sun, and finally they are pickled in brine, which is made of sea-water, saturated with salt to such an extent that an egg will float in it. In this way they are put in well-closed jars, and can be kept good for years. They should remain in pickle for a month before they can be used. These lemons so pickled and mixed with powdered sulphur clean and dry up all kinds of skin eruptions, in such a way that the granulating surfaces become a dry scab. Instead of sulphur, powder of 'pyrius' can be taken, and if too irritating it should be mixed with a little lime. Indeed the two together mitigate irritation, as much as we found lime and *Sirium* (a kind of plant) do in mastication.

"In order to give a blue colour to steel blades, such as swords, and those called *Krissen*, there are no lemons better than these. They are better than *Limo Papeda*, and *lemon carbou*, which are not used except for want of the former.

"Moreover in them there is some mucilage, which, when the juice is mixed with corrosive sublimate, or *Varinga** preserves and adheres to the blades better. If these arms be cleaned and polished by any other substance, then they are smeared over with this prepared juice, as was explained in chap. 37, by which they at once, from blue become darker. They are then lightly cleaned with a dry cloth, dipped in oil, and put by.

"Although in Europe we are taught that citrons can counteract every poison, the contrary is taught by the Indians. Certainly many poisons, not all however, are excited by lemon juice. This is established by these arms becoming covered with a blue colour. Moreover, those mostly forbid the use of this juice (in cases of poisoning) who may have (on some occasion) taken poison, and by experience had found that lemon juice gave it more power.†

"If eight or ten of these limes are cut and their juice squeezed into a clean pan and allowed to lie for a night or

* I have given the proper names as they are in Rumphius, but I fear many of them are wrongly spelt.

† It is not easy to get at the real meaning of these last sentences in the original.

eight hours, with half the quantity of water, a very good eye-wash is obtained, in which dim eyes are washed, if externally there be drawn over them a cloudy spot (leucoma ?), which hinders and bothers the sight.

"If these ripe limes be plucked by the hand, and suspended tied to a string, or some such other way, so that they do not touch each other, they can be maintained sound for a long time during sea-voyages.

"In the month of December, 1677,* a young branch of *Limo nipis* was put before me, the two inferior spines of which bore, on their tips, flower heads such as these trees bear, with one flower already open. When, however, this cut branch was placed in water for the night, both heads of flowers dropped off, as if they had been in some way fixed on.

"The leaves are used to rub the hands with, if anything unpleasant may have been touched. When crushed, they give a better citrine odour, while in others it is more sulphurous.

"The juice of these limes is also used in painting, and in preparing a pigment called *Cassomba.* For this purpose it is as good as that of *lemon Papeda.* For this purpose are also useful other kinds growing in Celebes, and on the east coast of Ceram. These varieties in Macassar are called *Tsjamburaga.* They are larger than *Limo nipis ;* externally granulose, and of a dark green. In the upper part (apex) they are smooth, where there is a small circle, in the midst of which a prominence is raised. The pulp of these resembles that of the common *Limo nipis,* and is acid, but its scent is not like that of the latter, nor is it so pleasant. The mountain people of Ceram, on the East coast, bring them down for sale to the villages of those coasts, where they are used cooked with fish, on account of their acid flavour. Certainly these can be kept longer and are more suited than others for carrying beyond the sea, as these and the *Limo nipis* don't easily decay." (*Vide* pl. 227, fig. *e* of Atlas.)

Observation.

Just as there are many varieties of lemons (Limonum), so there are many of Limes (Limonelli), which, properly speaking, are a smaller species than the former. Many varieties

* That is 210 years ago.

occur; not, however, so many as are made out by the below mentioned authors. Indeed, from the subsequent chapter, 40, (*Limonellus aurarius*,) this is clear.

" Many species of *Limonelli*, or varieties, are enumerated in Sloan, Catal. pl. Jam. p. 211, which are grouped with these, and which are recorded in Thes. nostro Zeyl., p. 143, where chiefly Indian species occur. Again, see Ray Dendr., p. 80; Plukn. Almag., p. 239; Ferrar. Hesper. Belgic., p. 209; J. Commelin Hesper. Belgic., p. 9; Valent. Amboin. descript., p. 190, &c."

(*Nota bene.*—There can be no doubt whatever that, both from its picture and its description, this *Limonellus*, or *Limo tenuis*, of Rumphius, *Limon nipis* of the Malays, is identical with the *kaghzi nimboo* of India, and the Lime of Monserrat —the C. medica var. acida, of Brandis and Hooker. I have entered into all the details of the uses of this *lemon nipis* which Rumphius gives, not because they are of much value at present, but because I thought them of some importance, to show to what extent this *kaghzi nimboo* was used in the Malay archipelago. It was not used only as a condiment in food, and preserved in sugar as a sweetmeat, but also used in medicine, and in the arts. Now, in order that 210 years ago it should be there (vulgatissimus et usitatissimus), it must at least have been known there probably some hundreds of years before, to spread all over those islands, and to have been found of use in the arts and in medicine. Nevertheless, although found "from Java to all the East Indian islands," it was *not found in forests, but everywhere near habitations, and carefully cultivated.*

Under those circumstances, there are only two ways of looking at it: (*a*) Either it was an indigenous variety, produced in course of cultivating other kinds, and raising them from seeds, as varieties are often thus produced in Europe and elsewhere; or (*b*) it was *introduced* " tale quale " from elsewhere. This lime is common to both Continental India and Ceylon, and to the Malay archipelago. There are other things which are common to both localities, such as " Capas " (cotton), and Cassomba (" Kussumb," Carthamus tinctorius), and *Krissen* (Kreese). There must therefore have been trade between these two places in olden times, especially along the coast of the Malayan peninsula, Burma, and

Bengal. Rumphius, moreover, states that this *kaghzi nimboo* was the one above others, which was particularly used "on sea voyages, as it did not spoil," and "that its seeds germinated very readily if dropped on the ground or sown." The question now is—did India get it from the Malay archipelago, or the latter from continental India ?)

(*i*) Chap. 40, p. 109, vol. ii.

"*Limonellus aurarius.*

"*Lemon Maas.*

"Dutch—De Gonde Liemis Boom.

"This is the smallest species of all the Lemons, the tree of which, nevertheless, grows as high as that of *Lemon nipis* (*kaghzi nimboo*). Its leaves are smaller than those of the latter, at all events narrower ; 2½ or three inches long, of which the cordate part is almost the third. They are not of so brilliant a green as those of *Limo nipis*, but are dark green and spotted,* and their aroma is not pleasant. Its branchlets (raches) are more scattered, and mostly hidden by the leaves, and the spines are of all, the smallest, and not many of them. The fruit is smallest of all, about the size of a large ...(?)... ball (globi sclopeti), spherical, and almost covered with small eminences, and mostly divided into shallow furrows.† Above (apex), it is umbellicate. It remains green for a long time, but ultimately becomes yellowish. The skin is thin, like a pellicle (*kaghzi*), and not very scented. The odour can only be elicited by scratching it, and the odour is not citrine, but rather aromatic, almost resembling *Lagondi.* The pulp is juicy, yellowish, transparent, and very acid, with many seeds of the size of wheat grains.

"In Latin it is called *Limonellus aurarius.* In Malay, *Limon Maas*, not on account of its likeness to gold, but on account of its use as shown further on. In other languages it is called by similar names (that is for the same reason).

* The leaves of the *lima* of Ceylon (C. hystrix) has its leaves spotted, and their aroma is not pleasant.

† All *thin* skinned Citrus have longitudinal depressions, or furrows, between the pulp quarters, especially when kept for a little time, as the thin skin moulds itself to the pulp as closely as a tight-fitting glove.

In Ternaté, *Lemo Tinagara ;* in Macassar, *Lemo Buleyu ;* in Amboyna, *Ussi Helawan.*

"It is found in Celebes, Ternaté, and Amboyna ; but in none does it grow abundantly. These lemons are not used in food, but mostly by goldsmiths, for cleaning every kind of golden article, which they afterwards intend to cover with pigment. For this purpose they use this lemon in preference to others, hence its name. They are also mixed with medicines and juices, and used for clearing eyes, for which they are better than others, as they are not so sharply acid and irritating. Where plentiful, there they are also used for washing the head and body, not so much for cleaning it, as to give it a nice scent.

"Compared to other lemon kind, the branches of this have many spines, short, thick, and hard.* The leaves drop off rather readily, and one part of the leaf easily separates from the other, and falls off (the leaflet separates from the winged petiole) ; so that the remaining part looks like the leaf of some other tree. The leaves, if crushed, have not much of the scent or taste of lemon leaves. (*Vide* pl. 227. figs. *c*, *c* of Atlas.)

Explanation.

Also described in Valent. Amboinæ, p. 190, under the name of *Lemon Amas.*

(*Nota Bene.*—This lime is thin-skinned and very small, with very acid juice, like a small *kaghzi nimboo*. But the rind and the spotted leaves have not a pleasant scent, although the character of the fruit has much of the *kaghzi nimboo ;* the leaves are more like those of the C. hystrix, that is, supposing the whole leaf to be 3 inches, its winged petiole or cordate part would be 1 inch, or about one third of the whole. Thus *Limonellus aurarius* appears to be half way between the C. hystrix and the *Limonellus proper*, or *kaghzi nimboo.*)

(*j*) Chap. 40, p. 110, vol. ii.

"*Limonellus Madurensis.*

"*Lemon Madura.*

"Dutch—Madurase Liemis Boom.

* If I have read Rumphius rightly, before he said with regard to spines, that there were not many of them (nec ita frequentes), all citrus, however, have more or less spines.

"In Madura a certain species of small fruit, or sweet lemon, occurs. It looks very pretty on its little trees, which are about 2 feet high. The branches, nevertheless, are strong, angular, and slightly striated. The leaves are solitary and simple, about the length of the thumb's joint, and are of a finger's breadth, not cordate, and with equal but sinuous edges. No spines are to be seen on the branches; the taste of the leaves is bitter, and if held against the light they present the usual oil cells of other kinds of lemons. The fruit is spherical, compressed in the upper part, pitted all over, and of the size of a (?)... ball (globi sclopeti). They always remain green, and without much difference in their sizes. The skin is thin and juicy; the pulp divided into cells, as is usual in other lemons; taste subacid, and at the same time aromatic; the colour of the pulp is orange, with only one seed; rarely two seeds are found, of the size of a wheat grain, acuminate at both ends.

"In Latin it is called *Limonellus Madurensis* and *Limonellus Pumilus* (dwarf); in Malay, *Lemon Madura;* this name, therefore, is probably from the island of Madura, situated in the gulf of the large island of Java, where it has its origin, and whence it has been brought, and carefully cultivated in the gardens of Batavia.

"The fruits are not eaten raw, but preserved with one or two of the leaves to give them a nice flavour; they are then served at table with dessert.

"To this I add, at the same time, another wild species of *Limonellus,* which was brought to my notice since 1694 called *Limonellus Angulosus.* The fruit differs from all other lemons. It grows near the edge of the sea. It is called in Malay *Lemon Utam* Basagi, &c., &c." (*Vide* pl. 93, fig. *a.*)

(*Nota bene.*—This *Limonellus Madurensis,* both from the picture and the description appears to be no other than the *kumquat,* or *kimquit,* of Calcutta, Lucknow, and other places. In Calcutta I am told it is grown in pots, for the decoration of porticos. Although Rumphius describes it as a dwarf plant, either it, or one very like it, called *hazàra,* can be grown to the height of 6 or 8 feet. Probably it is late in colouring, and as it is used in its green state for preserves,

they may not have given Rumphius any chance of seeing its orange colour. The same happens to the Kandy orange, which is eaten while green, and therefore never seen when of an orange colour.)

(*k*) Chap. 41, vol. ii.

"*Aurantium acidum.*

"*Lemon Itam.*

"Dutch—De Zunre Oranje-Appel Boom.

"Having described all the species of Indian acid lemons, there remains for us to treat also of the fruit of oranges, which constitute a peculiar genus, and which can by no means be produced from the foregoing kinds, either by artificial budding or grafting, as some Europeans have falsely thought and wrote. Moreover, these fruits throughout India grow in natural soil and among people who are not acquainted with the art of grafting and understand it not. Therefore I am certain that in the western part of the world this art (of producing oranges from lemons) had at no time been practised. Equally in Mauritania and Guinea, as in West India, and its islands, all the forests of these oranges occur growing spontaneously, and germinated there by their own natural power. These Eastern fruits, however, although they may differ somewhat from those in the West, as we shall show in the following pages, are divided into acid and sweet kinds.

"Therefore to begin with, acid oranges, commonly called *Lemoen Itam*, grow into tall trees, the trunks of which are rather thick, not round, but angular, and divided by furrows. The tree has many branches, and the leaves, after the pummelo, are the largest. The cordate part is small compared with that of others. The whole leaf, however, is 4 or 5 inches long, of which the cordate part is of the size of the width of one's finger, and very narrow. At the edge, the leaves are almost non-serrate and acuminate. They are smoother and of a darker green than in the foregoing kinds. They are distinguished by strong and sinuous transverse nerves, and if crushed they emit a strong sulphurous* scent. The spines are longer than in any other kind, and of the

* The scent of the Séville orange leaf, which this appears to be, is "sui generis," strong and aromatic.

length of a common needle, very strong and sharp, especially in young long branches. In these they are often of the length of one's finger. From the old branches and branchlets, however, they mostly disappear, so that they can be handled without injury, and if the tree be carefully deprived of its young long branches it can be easily climbed. The younger trees for a long time are certainly not thicker than one's arm, and everywhere, both on the trunk and on the branches, bear sharp and horrid spines. The flowers are white, like the preceding, with five petals, only they are a little larger. The fruits are spherical, oblate at both ends, without tubercles, and everywhere covered with marked foveoli. The colour is dark green till they become wholly ripe. If they remain on the tree for a long time, often they turn yellow, or orange, on one side, and some also colour all over; but these then are already over-ripe and spoilt. Their skin has a sulphurous odour, but less so than the sweet oranges, and it is of the thickness of about a thick quill. The pulp is divided into ten quarters, and they are as firmly adherent to each other as to the skin, so that they are not easily separated. This orange is, nevertheless, very juicy and mucilaginous, and as acid as the Spanish sour orange (Séville), but not so pleasant, and rather bitter. It has many seeds, oblong, rugose, and sinuous, with a white and thick shell; beneath that is a purplish pellicle, and inside all is a whitish kernel.

"The wood is whitish and sufficiently hard, but cannot be much used for implements because it is very crooked. This kind is more productive than any other species of lemon found in these regions. It fruits all the year round, and can be used daily. It grows in all soils, but above all, it prefers the proximity of human habitations.*

"In Latin it is called *Aurantium acidum;* in Malay *Lemon Itam*, that is black lemon (from its dark green colour); in Banda *Usse Mettin;* in Amboyna *Usse Metten.*

"It does not occur in all the islands of Maritime India. Moreover, in Java, Baleya, and Celebes, this orange is unknown. In Amboyna it is more plentiful, but in Ternaté and Banda it is rarely met with. Although these oranges are full of juice, nevertheless they are rarely, or not

* Presumably on account of the manure.

at all used with food, especially raw, as their juice, although vinous, is nevertheless unpleasant and slightly bitter. They are, however, used in a sort of rustic drink, called "Pons" (Punch); but for this, *Lemon Martin* is the best. This drink is not healthful, as it is made up of a lot of incompatible ingredients, which are mixed in raw. The bases of it, however, are the heating arack, and the refrigerating lemon juice.

"Then these dark green oranges are excellent for cleaning and polishing copper, whether alone or mixed with powdered charcoal, so that copper becomes bright and splendid, if at once it be washed in water and dried in the sun.

"These oranges are also very useful for washing the head, which they clean very well. They also clean off perspiration, and don't sting the skin as much as others. For this purpose they are first toasted over hot ashes, till they slightly burn and blacken; then they are cut and used. They can be also used for preparing *Cassomba* pigment, although not alone, but mixed with other lemons. They must be peeled before squeezing their juice. This is also done when used for cleaning copper.

"I add another kind, which mostly occurs in Macassar and Baleya, and is there called *Lemon Maritsja*, that is *lemon crispus* and, *Nitor piperis*, which is of the size of *Limo nipis*, or somewhat smaller, but at both ends either plane or depressed, resembling the sweet oranges of the Amboynese; externally rugose, and all over covered with small tubercles resembling grains of pepper, hence, probably, its name. Its skin, however, is thin, and can be easily peeled off, so that the pulp can be removed whole, as in the sweet oranges of Amboyna. Its pulp is acid and used with food by the people of Macassar.*

"Of this class a huge variety occurs in Amboyna, the fruit of which grows to the size of an infant's head. Externally it is granulated, and has few seeds; the pulp, however, has a feebler flavour than the common ones."

Observation.

As of lemons, so of oranges, many are the varieties which have been enumerated by various authors. This also occurs,

* In India there is a small sour orange of the "*keonla*" or "*sùntara*" type, called "*khatti naringi*," or "*bannati benàrsee nimboo*."

viz., that "the pulp of the common orange (Aur. vulgare) is sour"—Ferrar.-Hesper., 377, and Boerh. Ind. H. L. B., p. 239, where see other varieties, also in many other authors quoted in Sloan. Catal., pl. Jamaic., p. 210, and the elegant figure in Blackwel. Herbal., Tab. 349, &c.

This kind is also described by Valent. in Amboin., p. 190, under the name of *Lemon Hitam*.—(*Vide* pl. 1, figs *a* and *b* of Atlas.)

(*Nota bene*.—The variety first described and the picture agree completely with the characters of the *Séville orange*. Although often the Séville is rough and subwarty, especially round the apex, I have met with specimens in South India which are spherical, and almost smooth. In Lucknow, the Séville orange called *nàranj*, is often as smooth and shiny as an apple. Moreover, from Pertabghur, Oudh, I received a specimen which was rather ovoid, like an egg orange. Rumphius only mentions the use of this bitter orange for punch, for cleaning copper, and for washing the head and the body; also for preparing the *Cassomba dye*. He makes no mention of its being used in any way for preserves, so that it is likely the Chinese did not use it as a preserve either; otherwise, the Chinese residents would probably have imported this art into the islands of the archipelago. The tincture of bitter orange peel is probably of Arab origin, as they were not only acquainted with alcohol, but they used the bitter orange in their Pharmacopœia. I have never read or heard who it was that first made candied orange peel, and marmalade out of this orange. The Chinese preserved other kinds of citrus in various ways, and probably the idea was taken from them. The extraction of essences from its flowers, leaves, and peel, was probably of a much later period.)

(*l*) Chap. 42, p. 113, vol. ii.

"*Aurantium Sinense.*

"*Lemon Manis Tsjina.*

"Dutch—Sineese Orange-appell Boom.

"These fruits, by all the common people of Amboyna, are considered indigenous; but it would be better to group them with the other Chinese oranges, chiefly for the following reasons: This tree is slightly taller than the preceding

(Séville), with erect branches; its rounded head, however, is larger and fuller. The leaves are narrower and more acute than the foregoing; three or four inches long, smooth, with sparse nerves, and scent similar to the first (Séville). The cordate part is as long as the breadth of one's finger; but so narrow that its cordate form can scarcely be made out.* It is, however, slightly broader than that of *Limon Martin* (*therefore* fig. 1. Tab. 24 of Rumphius *cannot* be *lemon Martin*, but *lemon Purrut*, as it has an immense "pars cordata;" therefore also lemon Martin must refer to fig. 2 of same Tab.—E.B.). The young branches have long and narrow spines;† in the adult ones, however, none are perceptible. The fruit has two forms. In one the oranges are larger than in the other. The larger ones are like the foregoing (Séville) or a little smaller; spherical, except near the stalk, where there is a protuberance; at the top (apex) it is depressed and pitted with foveoli. The rest of the rind is smooth, but it has many small foveoli. The skin is rather thick, fungous, and easily detached from the pulp. Externally, from green it turns darker, although it be wholly mature.‡ Moreover, the skin is bitter, sulphurous, and with a very strong scent; if broken, it emits a sort of vapour (spray of ess. oil). If these oranges are plucked and kept for some time, one part turns yellowish, as if they were true oranges. If, however, they ripen on the tree and become wholly yellow, they are considered dry and useless. These mostly do not acquire their full size, but drop off in that state.

"The pulp of these is similar to that of the Spanish orange, divided into many segments adhering closely together, and forming a globe; the centre is hollow. If eaten, the pulp should be carefully cleaned of its dry, pithy fibres, which are bitter. If this be done, it is easy to separate the segments and eat them. The colour of the pulp is reddish-yellow, semi-transparent, and sweet, with little vinosity (sub-acidity). The seeds are rather long, rotund, and solid.

* Like the petiole of all the *sùntara* type of oranges, it is only just *margined.*

† The young branches that probably Rumphius refers to are the long canes given off from the main trunk, or from the thicker branches.

‡ In Kandy they have a similar *sùntara* orange, which, they say, does not turn of an orange colour.

"The other variety of this orange is a little smaller and smoother, depressed at both ends, more like the Spanish orange, externally covered with minute foveoli, and with a thin skin, thicker round the stalk. The skin is also easily separated from the pulp, which is like that of the larger variety. This orange becomes yellower when on the tree, and, if kept for some time, becomes completely yellow, like true oranges. These trees, in Amboyna, are not productive; at least, they do not fruit every year. The trees, moreover, must be of full age before they bear fruit. They like the plains, and full exposure to the sun. Those that grow on the cold hills of Amboyna mature their fruit very slowly, and are mostly acid. These same trees do not grow to a very old age; they often give out an acid fluid, and exude gum copiously. Then, for one or two years, they give a large crop, which turns yellow on the tree, and afterwards the tree dies. This evil can be somewhat prevented, but only for a short time; if, for instance, the tree be so perforated, as to part with its superfluous sap. Others, on the contrary, drive a strong iron nail into the trunk.

"In Latin it is called *Aurantium sinense.* In Belgian, *Sinese appels.* In Malay, *Lemon Manis Tsjina,* which name is applied best to the last or smaller variety, since it grows more frequently in China, and is preserved in sugar by the Chinese, and sent everywhere.

"Some, however, as has been stated, call these fruits sweet oranges of Amboyna, especially the first kind, which is mostly cultivated by the Amboinese on their hills. By the Portuguese it is called *Laranza;* and in Spanish, *Naranza;* but by the Indian Portuguese *Limondoce.* The true Latin name of this kind is *Malum aureum,* and *Hespericum,* from which some think that *Pomum aurantium,* and the Italian, *Pomeransi,* are derived. I, however, think that all these names have had their origin from the new Greek word νεράντιον, and this from the Arabic *nerang,* or Persian *naring* or *naran,* which word denotes this fruit; and which, without doubt, the western Arabs (Œthiopes) once introduced into Spain, afterwards degenerating into *Naranza.* The new Latins, however, being ignorant of the origin of its name, call it *Aurantium,* which squares better with the golden

colour, and the name of *Pomi aurei.* By the Javanese it is called *Djerroc Leeki;* in Macassar, *Lemo Songalêa,* that is, Chinese lemons; but in Amboyna they are called *Massussu,* and by the Chinese, *Tyng-Cam.*

"Some Romans attributed to Palladio the honour and glory of first introducing into Italy the Asiatic citrons and lemons.

"This is very true of those fruits, but by no means true of the oranges, as the name of *Hesperium Pomum* amply shows that it came from the western parts of the world. The oriental, and especially these Indian oranges, do not differ in the least from the Spanish or occidental oranges, either in foliage or green colour of the fruit.* It is easy to see that neither the western oranges were propagated from the eastern, nor the eastern from the western; and much less so were both of these produced artificially by grafting from citrons.

"They are found in almost all these oriental islands, from Java, Celebes, and the Moluccas, to Amboina.

"Many eat them raw on hot days to revive the stomach, but they act best on an empty stomach. The Chinese, in their own country, have very elegant round oranges of the second variety, which are smaller than the common kind. These they preserve whole in sugar, by making fissures in them, and flattening them into the form of large discs. In these little or no bitterness can be detected. They fill jars with them, and export them to other places. The Chinese inhabitants of Java preserve them in a similar manner, but, they do not know how to cover them so elegantly with sugar as they do in China. The Chinese also send these same oranges, wholly dry, wrapped in paper, to other countries; they are very grateful to the sick." (*Vide* pl. 116, (A) figs. *a*, *b*, *c*, and *d*, of Atlas; also, pl. 93, fig. *b*, which are the same.)

Observation.

This tree is called *Malus aurantia sinensis* by Jonstone, in Dendrol., p. 26, and in Sloan, Catal. pl. Jam., p. 211; and *Aurantium sinense* by Ferr. in Hesper., p. 430. It is that which is called *Malus aurantia humilis* by Casp. Bauh. in

* It is probable that Rumphius had not noticed the difference between the Portugal orange and the *sùntara* type of orange.

Pinac., p. 436, after Plukn. in Almag., p. 238, and *Mala aurantia sinensia* by Valent. in Histor. simpl. reform., p. 212; and in Amboin. descript., p. 189, which closely resembles that called *Malus aurantia regia, dulcis, Zeylanica* in Thes. Zeyl., p. 39, &c.

(*Nota bene.*—Both the picture and description of this orange agree with the characters of the *sùntara* orange of India. On the back of the Tab. 34, from which I took these tracings of pls. 116 and 93, Buchanan Hamilton wrote: "The larger variety is the Sylhet orange," (*kamlà lemboo* of Calcutta,) and the "smaller variety the Midnapore orange." Rumphius states that the larger variety does not colour, and remains green even when ripe, like the so-called "green orange" of Kandy. It is not, therefore, improbable, that this very variety of *sùntara* orange was introduced by the Dutch or the Portuguese into Ceylon. The Indian varieties of *sùntara* are all *orange* by November and December, and are not considered fit to eat till they are quite orange all over. In the description of the Kandy green orange, it will be seen that by keeping it turns completely yellow, as Rumphius states.)

(*m*) Chap. 43, p. 115, vol. ii.

"*Aurantium verrucosum.*

"*Lemon Manis Besaar.*

"Dutch—Zöete Oranje-appel Boom.

"Of all the kinds of lemon trees, this has the tallest trunk and head, but its branches are not so erect as in the foregoing. Younger trees have some spines, but old ones certainly none; sometimes, however, their remains are found on the branches, without points and harmless. The leaves are similar to those of the preceding, or somewhat larger, more than five inches long, and of three fingers' breadth; acuminate, and slightly dentate at the tips. The cordate part is small, and can scarcely be made out, especially in adult trees (meaning that the petiole is only just margined); in younger ones, however, it is long and narrow, and can be better distinguished. The scent is more feeble than that of the preceding, and the flowers have also five oblong and white reflexed petals, larger than in others, the pummelo flowers excepted, to the grateful scent of which they

approach. The fruit is larger than that of the foregoing; about as large as two fists, perfectly spherical, but covered with several large and hard warts, as if they were boils. Its skin, however, does not become of so dark a green as in the foregoing, but paler, and is not so thick and sulphurous, and very firmly adhering to the pulp; so much so, that it cannot be separated, but must be cut with a knife. The pulp is divided by many, but simple pellicles, which however cannot be separated into segments as in other oranges, nor is its colour so reddish as in the foregoing, but yellowish, semi-transparent, sweeter and more juicy than the foregoing; hence many prefer it to that. This sweetness, moreover, is not so mixed with that sub-acid (vinoso) flavour, but is more feeble and resembles that of cherries. The seeds are plentiful, and larger than in the foregoing, and the centre is not hollow. The Amboinese do not care for, and do not cultivate this kind, as it does not suit cold hills, but likes a gravelly black soil, mixed with sand, and well exposed to the sun, such as can be made in villages near habitations. By Europeans it is more frequently planted than the preceding, as it grows more quickly, fruits earlier, and is more productive, compared with the foregoing.

"In Latin it is called *Aur. verrucosum;* in Belgian, *Zoete Appelen;* in Malay, *Lemon Manis Bezaar;* it is also called *Lemon Tsjina* by the Amboinese, as this is mostly cultivated by the Chinese inhabitants. In Ternaté, it is called *Siricaya.* In China there are two kinds; one common, which is there called *Bit-cam;* that is *Limo regius*, and the other *Seng-cam.** The latter is double the size of the common kind, but not so sweet.

"The variety under consideration is not so common as the foregoing (the loose skinned *sùntara*), it having been brought by the Chinese, and other strangers, to these islands, from elsewhere.

"It is much eaten raw, and served at table with dessert. On such occasions the skin is removed by a knife, and the pulp cut obliquely, not transversely, into pieces, and the pulp part saved as much as possible, as mostly this orange consists

* *Seng* and *Cam* may have entered into the names of the Indian oranges "*sùngtara*" and "*kàmala.*"

of a number of simple large seeds, very closely set. The Chinese give this kind mostly to the sick, to invigorate their stomach, and excite their appetite, as it has no subacid irritant (vinosam acrimoniam) like the foregoing, and it does not make one perspire so much.* This however should be noted. These oranges should not be eaten in quantity after dinner, when the stomach is filled with various kinds of food, and especially when filled with milk, as then a choleraic flux may be often caused. I have seen this produced in a whole family of very well-to-do people, who, after drinking milk, used to eat these oranges.

"In Banda there is another variety which has sweeter fruit, and its exterior is similarly covered with warts. Its pulp is white, and wholly sweet when ripe; indeed sweeter than those of Batavia. It is called *Limon Pouleron;* it occurs also in Plo-ay.

"In Madura, there is also a sweet kind of lemon, which is smallest of all, indeed smaller than *Limo Nipis*, with a thin skin, and not bitter; its pulp consists of many soft granules, and is very good preserved, for which purpose the Chinese inhabitants of Grissecka use it; this latter place is situated in the region of Madura.

"In Latin it is called *Aur. Pumilum Madurense;* in Malay, *Lemon Suassi*, and *Lemon Colte.*

"The branches of all kinds of lemons (Citrus) are so manipulated and transplanted, that within a few months they begin to bear fruit. Such branches of old trees are selected as seldom bear fruit or buds. These are placed against the trunk, and pounded with a stone, so as to slightly bruise the bark. Then this part is covered with a rich and tenacious earth, so that it may not fall off. It is then enclosed in a split bamboo, or other integument. Such branches are afterwards let alone for five or six weeks, during which time you may reckon that the bruised part has emitted roots into the surrounding earth. Then the branch is cut off below the split bamboo, or other substance used as a wrapper, and planted as it is in a box full of good and rich soil. Then within a month it begins to fruit, but not more than once or

* It is curious that Rumphius had discovered that Citrus juice checks perspiration, and therefore *quenches thirst.*

twice, and afterwards perishes. If, however, it is placed in a fertile soil, it grows into a perfect tree. This mode of propagation is a common and profitable custom among the Chinese inhabitants of Batavia. They hire for themselves certain gardens, or lease a piece of land for a series of years. They practise this art with the object of obtaining fruit immediately. Others, in order that old trees may become productive, cut off many of their branches, and transfix the trunk with a strong nail. This can also be done, and is equally effective with the trees called *Nanca*, and *Bonga Tanjong*."

Observation.

This appears to be the same species, or at all events, variety, which is called *Aur. Stellatum*, and *roseum* by Ferrar in Hesper., 395. (*Vide* pl. 59, figs. *c*, *d*, *e*, of Atlas.)

(*Nota bene.*—This *Aur. verrucosum* appears to have all the characters of the Portugal or Malta orange, but it is a warty variety. It was not, however, common in the Malay archipelago in the time of Rumphius, some 200 years ago. It appears to have been then of recent introduction in those islands. Rumphius thought it was brought by the Chinese, and speaks of it in connection with the Chinese inhabitants, the natives not having at that time taken to it. Europeans however, frequently planted it in their gardens. On the back of Tab. 35 of Rumphius, Buchanan Hamilton wrote "*Chândpur orange*." What the latter is I don't know.)

No. 42.

The following layering-clay is successfully used by *Girdharì Chawdree*, of the Horticultural Garden, Lucknow. He uses it with advantage for those plants that are difficult to layer. His receipt for making it is the following:

5 seers, linseed oil-cake (alsi-ki-khalì).
5 seers, Paddy husks (dhân-ki-bhusì).
5 seers, *urud* flour (urud-ka-atà).
5 seers, fresh cow-dung.
125 seers, clay (chickni-mitti).

All these ingredients should be mixed well together, and allowed to decay thoroughly in water, in a large *nand*, or tub. As may be surmised, the perfume this compound gives off while decaying, is not agreeable. *Girdharì* says that to ascertain whether this layering compost is fit for use or not, a green twig of any tree should be introduced into this clay. If by the following morning, its green colour is unchanged, it is fit for use; otherwise, it should be allowed to ferment and decay for some time longer.

The way he uses this composition is as follows: He selects a branch suited to layering. Under a joint he tightens a bit of twine, so as to cut into the bark, and then knots the twine. He then wraps the tied part in this layering clay, to the length of about four inches, and two inches across, giving it a spindle shape. He binds the whole with cloth and string, and bends it U-fashion in a pot of rich soil, putting a heavy brick on the top of the earth, in order to prevent the layer from springing out. The tightened string appears to check the flow of sap, and cause a sort of callus to be formed. The clay appears then to stimulate the formation of roots, which, finding a rich pabulum, develop quickly and fill the pot. The pot, of course, should be watered when necessary. By this means layers have been taken from plants which will not otherwise root; and those which took a year to form roots could, by this method, be made to do so in a few months. Instead of twine, a bit of wire tightened round the bark by means of a pair of *pliers*, would answer as well, if not better. The Malta lemon roots so readily when layered in the hot weather and rains, that no clay is needed, but only the tightened string. Other kinds of citrus, however, take much longer to root, and therefore this layering clay might be very useful where rapidity of layering was an object. The clay should be prepared some time before it is required. I found that in the hot weather, if the pots are watered regularly, and in the rains, when the foliage was active, the layers rooted more quickly than in the winter. When roots are formed, they can be easily seen on the surface of the pot, under the brick; often they may be seen peeping out of the drainage-holes, which should be at the sides, on a level with the bottom, and not at the centre of the

bottom of the pot. Weeds should be kept out of the layering pot.

No. 43.

(*a*) Mr. Stevenson, of Sylhet, has kindly given me the following names of the varieties of citrus grown in the Khasia hills. I give them here because they differ slightly from those given by Mr. Jerman Jones (See chap. on Origin of Citrus, &c.).

Bengali Names.	*Khasi Names.*
1. Kamalà	Uso Santra.
2. Naringhi	„ Sim.
3. Moglài	„ Mongar.
4. Satkara	„ Kuhit.
5. Kàki	„ Yanpriang.
6. Khàtajamir	„ Komphor.

Of these (2) *Naringhi*, (5) *Kàki*, and (6) *Khàtajamir* are sour, and smaller than the sweet oranges, though of the same family. (4) *Satkara* is like a citron, and is not eaten ripe, but is cooked green, and used as a kind of sour *chutni*. (1) *Kamalà* and (3) *Moglài* differ little. The rind of the latter is somewhat thicker, and its colour lighter than that of the common orange, the *Kamalà*. (*Vide* pls. 256 to 258.)

(*b*) Mr. Anderson of Sibsàgur, Upper Assam, gives the following names of the varieties of citrus there found. (See pls. 234 to 239.)

1. Rabàb Tenga.
2. Jora Tenga.
3. Sàkla Tenga (bitter lime).
4. Bar Tenga (big lime, *not a pummelo*).

Also *Naga Tenga*, grown in Naga villages, at an elevation of 1,500 feet.

No. 44.

In 1857 Capt. Lowther, writing "on the Flora and vegetable products of Assam" in one of the journals of the A. H. S. of India, says, "The various species of oranges and lemons in Assam would astonish you. In the garden at Saikwah —the post I have just deserted—is an orange-tree 40 feet high, which bears thousands of fruit. There are several other trees of smaller dimensions. Lemons of the finest kinds are found wild throughout the forests, and are a great treat to a thirsty, feverish explorer. I often come on a loaded tree in the midst of a grass plain, with no water nearer than some miles. They are doubtless the remains of an ancient cultivation. . . . . The very best citrons I ever saw were growing wild last month on a barren island of nearly pure sand, on the Upper Berhampooter. The growth of the tree was very remarkable for any plant of the Aurantiaceæ. The lower branches were trailing creeper-like along the ground,* and were heavily laden with bunches of ripe perfumed fruits, some weighing more than 2 lbs. apiece. I have converted several into candied citron, and can vouch for their delicious flavour."

(NOTE.—It is not improbable that the soil in all those hills is very suitable to the growth of the Citrus tribe. As to their dissemination, nothing is easier, both by the aid of monkeys, parrots, and other animals carrying the seed about, and by means of inundations. Almost all the citrus float well, and could easily be carried long distances during floods. If stranded anywhere on land, the fruit would eventually decay and the seeds would germinate. The orange-tree 40 feet high, which Capt. Lowther mentions is not likely to have been of the *sùntara* variety, as this does not, as far as I know, grow to any great height. It was probably of the Séville group, or possibly of the Portugul variety, and probably a seedling. In fact, all he saw were probably seedlings.)

* Rumphius also mentions this rope-like character of the branches of the Citron.

No. 45.

Gardeners' Chronicle, 31st July, 1886, p. 154—Article, *Citron.*

"In recent consular reports, appear interesting accounts of this well-known ingredient of plum-puddings and wedding-cakes. Leghorn Citron is what it is usually termed, but little or none of the article is grown there, Sicily and Corsica furnishing the supply of the new fruit. The Citron-tree is of the Citrus family, and is as nearly like the lemon as it can well be. It is propagated principally from cuttings, and flourishes near the sea in sheltered positions, and in warm and sandy soil. The tree resembles somewhat an overgrown bush, and as citrons often weigh from 6 to 8 lbs. each, the branches of the tree must be supported by props. The trees are subject to peculiar constitutional diseases, which kill without mercy. As the profit of the grower depends largely upon his favourable situation, &c., it is hard to make even a rough estimate of the business. Supposing the trees to be planted 3 yards apart, and allowing fourteen citrons to each shrub, the average weight of the fruit per acre would be 9,346 lbs. The price of this fruit in Leghorn is about six cents per pound, but from this must be deducted costs of casks in which the fruit is shipped, about three dollars, and cost of cutting and packing the fruit, two dollars per cask; then general expenses of the citron farm are estimated at sixty-eight dollars per acre. The Corsican and Sicilian grower packs the fruit cut in halves in casks with brine and ships it to Leghorn, where there are nine factories for candying citron, employing 300 men. On arrival there in these casks, the fruit looks like huge lemons with tremendously thick rinds, and little substance inside. They remain in pickle some thirty days, and are tough and bitter. They are then boiled in fresh water till soft, cut into quarters, and all the seeds carefully removed. They are then placed in jars with hot syrup, and for about three weeks the proportion of

syrup* is constantly increased until no more sugar can be absorbed. The proportion is 80 per cent. of sugar to 100 per cent. of fruit. The quarters are finally placed on wire netting to dry, and when ready are packed in the small wooden boxes so familiar to us. Citron, in short, may be described roughly as the thick peel of a species of lemon, pickled to extract its bitter flavour and absorb the oil ; then boiled to make it tender, and saturated with sugar to make it palatable. As with other articles of commerce, so it is complained that the prices of citron are largely regulated by speculation, varying from 19 cents to 12 cents per pound at Leghorn. A curious fact is that more citron is imported into Italy than exported from it, the proportion for the last three years being as ten to one.† The soil of Cuba is eminently adapted to the Citron shrub, but few trees are, however, grown there, everything being abandoned for the staple crop—sugar-cane. It seems so hard for communities to learn the lesson of diversified crops; all sugar-cane, all cotton, or all wheat apparently must be expected. Cuba, Mexico, and California offer advantages in the culture of the Citrus fruits, and are only awaiting enterprise to develop these profitable pursuits." —*American Grocer.*

No. 46.

Malta lemon pickle (according to Baboo Sukhi Lal's receipt).

(*a*) Remove the skin of the lemons as completely as you can, then cut the lemons into four quarters lengthwise, but not completely, so that the quarters may still hold together. Then between the quarters fill in the following mixture of spices and other ingredients, and pack the lemons so prepared in a jar, which is to be rolled daily for four or five minutes for a whole week. After that, pour in a quart bottle full of fresh lemon juice, and continue the rolling daily until the pickle becomes fit to eat.

* Probably the writer means that the syrup is re-heated daily, and further concentrated.

† The reason is that a large quantity of candied citron is used in Italy by confectioners.

1. Nàmak (salt)	10	chatanks*
2. Zeerà (caraway seed (?)) . .	4	„
3. Gol-mirch (black pepper) . .	2	„
4. Dhunià (coriander) . . .	8	„
5. Adrak, or sônth (ginger) . .	2	„
6. Ilàici (cardamums) . . .	2	tolas
7. Laung (cloves) . . .	1	tola
8. Hing (phulà) (assafœtida) . .	3	mashas

Pound all these ingredients finely and mixed then thoroughly, and add half a bottle of lemon-juice; then mix them further and stuff the lemons between the quarters with this mixture. This quantity is enough for fifty lemons. By *Phulà-Hing* this is what the Baboo means. Wrap the *hing* in a bit of teazed cotton, and burn it on a bit of cowdung fire. When the cotton is half burnt, the *hing* is to be pounded and thoroughly mixed with the other ingredients.

He particularly impressed upon me that in order to keep this pickle in good condition, from the time of being put into the jar, it should neither see daylight nor the light of a lamp, that is, it should be kept covered up and in a dark place. When wanted for use, a lemon can be taken out by the hand, without exposing the jar to the light.

All I know about this pickle is that it is very nice, and good to eat with meat, curry, &c. The *baboo* added that he formerly made this pickle from limes, but now that he had tried the Malta lemon, he would never use the lime again, if he could get the lemon.

(*b*) Others pickle limes, skin and all, in brine and other ways, much in the manner mentioned by Rumphius in the chapter on Limonellus or *kaghzi nimboo*, which see.

(*c*) The *Gulgul* of the Punjab (pl. 186, figs. *e* and *f*), I am told, is pickled by cutting it into thin slices and packing it in alternate layers with salt, pounded ginger, and *jeera* (caraway). When the rind is well softened by the brine, this pickle is used in cases of enlarged spleen.

* A *chatank* is 2 ounces; a *tola* is a Rupee's weight; and a *masha* about the weight of a grain of wheat."

No. 47.

Mr. R. Blechynden, Junior Secretary to the A. H. S. of India, kindly sent me the following information. He thinks that Comilla, or Kumilla, the capital of Tipperah, the district near Dacca, on the east and south of Mymensingh and Sylhet, is close enough to the Khasia hills to make the suggestion, that oranges may be found wild there, plausible. He, however, adds that Dr. Hunter, in his statistical account of Bengal, says that the *Pati nebu* and limes are products of Tipperah, but oranges are not common.

(NOTE.—I have a suspicion that neither *kamlà* nor *sùntara* are names of *Indian* origin, but probably take their origin from the Chinese *Kam* and *Seng*.)

Mr. Blechynden further says that "from the few words with which Roxburgh, in his 'Flora Indica,' dismisses the subject of oranges, it would appear that they were very little known in Calcutta in his time." He says: "As they do not thrive in any part where I have been stationed, I cannot well enter into any satisfactory account of them." Yet, in the "Hortus Bengalensis," it is stated that plants were in the Botanic Garden (Seebpore) before 1794, and that they were introduced from Sylhet.

In Robinson's Assam (1841) the native names for different kinds of citrus are given; they are many, divided into acid and sweet limes, sub-acid and bitter lemons. He also gives two shaddocks, three citrons, and three oranges.—(*Vide* Appendix, No. 54.)

No. 48.

Dr. Maglieri's decoction of lemon.

Cut a lemon into thin slices, peel and all; add three breakfast-cups of water, and boil on a slow fire, and in a

glazed or enamelled vessel,* until the liquid is reduced to one-third. Then allow the whole to stand exposed to the air for a whole night; and early next morning strain and squeeze the whole, and give it, all in one dose, to the patient on an empty stomach. In bad cases, it is better to give a similar dose again in the middle of the day. In that case, double the above quantity should be prepared every day. This remedy should be continued until the patient is quite well. Instead of one lemon, you can use three limes similarly treated, or half a large *khatta* orange, or Kumaon lemon, or a Sèville orange, or any similar quantity of any sour citrus.

For intermittent fever, weakness, and cachexia after intermittent fever, or for enlarged spleen of recent standing, this decoction of lemon is very useful. For enlarged spleen it is only equalled in my opinion by *Fluoride of Ammonium.*

No. 49.

Orange marmalade ("Francatelli's Cook's Guide").

Split the Séville oranges in quarters; use a sharp knife to cut out the fruity pulp from each quarter, without any of the white pith left on it; and, as this is effected, pick out all the pips, and put the fruity portion in a basin, and the quarters of the peel into a large pan containing water. When this is completed, boil the quarters of peel in water until they are soft to the touch; they must be then drained and put to soak in cold water for twelve hours; they are then to be again drained on sieves (or any basket work) for two hours at least, to rid them of all unnecessary moisture; after which, they must be cut up in thin shreds by means of a sharp knife. Next, weigh the shreds and also the pulp, placed in reserve in a basin. For every pound of the total weight, allow three-quarters of a pound of white crystalline sugar—(Cossipore crystalline sugar is the best, being totally

* Metallic vessels are objectionable for boiling acids in. Common earthen vessels, without glaze, would absorb much of the liquid. In Agra they make cheap *glazed* saucepans, much used by Mahomedans.

free from treacle); then boil the sugar to the pearling degree,* then add the fruity part, sliced very thin, and the shred peel; boil for twenty minutes more, stirring the whole time.

No. 50.

Candied lemon and orange peel (from an Italian cookery-book).

Split some Malta lemons or Séville oranges into four quarters, and remove the pulp as before (which, in this case, will not be wanted, and can be utilized in other ways). As you effect this, throw the peel into cold water. In the meantime boil some other water and cook the quarters of peel in it till they are tender. Then lift them out of the boiling water, and put them again into clean cold water for two days, renewing the cold water two or three times a day. Then take them out of the water and drain them. In the meantime boil some sugar to the pearling degree,† and when tepid, immerse the drained peels in it, and leave them there for eight days, taking care, however, to remove them everyday, and reboil the sugar to the pearling degree, and, when tepid repeat the former operation. On the eighth day, reboil the sugar as before, and simmer the peels in the hot sugar until, taking a little of the sugar and cooling it, you find it crumbles in your fingers into a flour-like powder. Then quickly remove the peels, and drain and cool them on sieves or other similar surfaces. Finally dry them in a slow oven (or in India in the sun, on dishes protected from the flies, with wire covers, or other similar appliances).

I think citron peel, after pickling in brine, to remove the bitter taste, can be candied in this way also.

Anybody with leisure, and not in a hurry to make a fortune, might do a good service by experimenting on all the peels of the different varieties of Indian citrus. Natives,

* By this is meant the *pearl-like* bubbles which form on the surface of the boiling sugar, at a certain stage.

† *Vide* preceding note.

owing to their patience, are suited to work of this sort; and any philanthropic person or society might do them a service by teaching them how to candy citron, lemon, and orange peel, so that they might be had fresh, and much nicer than the hard, stale imported candied peels. These are small industries, quite suited to natives with small capital.

No. 51.

Lemon jelly (originally taken, I believe, from the *Queen*).

Slice the lemons very thinly, removing all the seeds. To every pound of lemon, allow three pints of water. Soak the sliced lemons in this water for twenty-four hours; then boil them in this same water till quite tender, and let them stand another twenty-four hours. Weigh one and a-half pounds of Cossipore white sugar (any trace of treacle in the sugar will spoil this jelly) for each pound of the boiled fruit and water. Boil the sugar, water, and lemons till a little, cooled on a plate, will set like a jelly.

This receipt is applicable to limes, oranges, and other citrus. It is a thin gelatinous marmalade, and, in my opinion, much nicer than the thick, jam-like marmalade of the shops. It is a nice way of using the antiscorbutic qualities of lemons, and ought to be a good tonic.

Fresh fruits make the best flavoured preserves. Eaten with toast and butter, or cream, this jelly is very good.

No. 52.

In St. Domingo, Risso had met with an *oranger à fruit rugueux*, a large, thick-skinned orange, furrowed and subwarty. (*Vide* pl. 40, fig. *d.*) Curiously enough, its fruit was there given by preference to *sick people enfeebled by fever.*

There are many instances on record in which various kinds of citrus were given with advantage in cases of fever, although the *kind* of fever is not often mentioned. (*See* chap. on the Uses of the Citrus.)

No. 53.

As I had not always an opportunity of seeing the citrus trees in flower, I asked Mr. Ridley and Mr. Gollam to note the colour of the flowers, and that of the young shoots in spring. They sent me the following, which may, perhaps, be of service. The names of the trees are given in the vernacular.

From Mr. Ridley, Lucknow :—

1. *Shèrbetee*, or *Mitha Nimboo*—flowers large, Malta lemon size ; *pure white ;* shoots green.

2. *Kaghzi Kalàn*—flowers *very slightly* tinged with *magenta red ;* shoots green.

3. *Behàri nimboo* (*large*)—flowers, large, *coloured red ;* shoots green.

4. *Behàri nimboo* (*small*)—flowers, *dull crimson ;* shoots green.

5. *Gangolià nimboo*—flowers, small, *very faintly coloured red ;* shoots green.

6. *Orange-fruited Jhambìri*—flowers, *small* (size of *keonla* orange), *faintly coloured red ;* shoots, green.

7. *Yellow-fruited Jhambìri*—flowers, size of the last, with the slightest possible tinge of *reddish crimson ;* shoots, green.

It should be noted that the tinge of bronze in the young shoots turns green as they develop, and possibly the foregoing had gone beyond the bronze stage, if any of them had it.

From Mr. Gollam, Saharunpore :—

1. *Rungpore lime*—flowers, small, white, tinged purple ; young shoots, green.

2. *Sweet Gulgul*—flowers, large, white, tinged purple ; shoots, bright green.

3. *Sour Gulgul*—flowers, large, white, tinged purple ; shoots, green.

4. *Malta lemon*—petals and calyx, tinged purple ; shoots, bright green.

5. *Karna* or *Khattà*—flowers, white, tinged purple ; shoots, green.

6. *Turunj*—flowers, large, tinged purple ; shoots, green, occasionally tinted purple.

7. *Bîjouri*—flowers, large, white ; shoots, green.

8. *Sadàphal*—flowers, white, slightly tinged purple, occasionally pure white ; shoots, green ; the whole tree extremely thorny.

9. *Keem*—flowers, large, pure white ; calyx tubercled ; shoots, slightly hairy.

10. *Amilbêd*—flowers, small, ¾ inch diameter, white, tinged purple ; shoots green.

11. *Jhambìri*—flowers, small, ½ inch diameter, white, faintly tinged purple ; shoots, green.

No. 54.

The following notices of citrus varieties are taken from Will. Robinson's "Account of Assam":—

Acid limes.—Nimu Tenga ; Ghorá nimu tenga.

Sweet lime.—Mita nimu tenga.

Acid limes.—Jamir tenga ; Hamir tenga ; Páti salung tenga ; Bar salung tenga ; Cháklá tenga ; Narengi tenga.

Sub-acid lemons.—Cháklá tenga ; Nágá cháklá tenga ; Halangá mori tenga ; Jora mori tenga ; Bor mori tenga.

A bitter lemon.—Tita-Karuna ; Dewa tenga ; and a *sweet lemon*, called *Páni mori tenga.*

Shaddocks.—White, *Bogá robab tenga.* Red, *Ranga robab tenga.*

Citrons.—Bor jorá tenga ; Birá jorá tenga ; Bon jorá tenga.

Oranges.—Hintoriá tenga ; Kamalá tenga ; and Jendru tenga.

(In writing of the Assam vegetables, he mentions four classes. The fourth class he calls *Tenga*, or acids used as seasoning.)

No. 55.

In Voigt's *Hortus suburbanus Calcuttensis*, p. 141, the following varieties of citrus are enumerated :—

1. C. decumana—*Batàvi-neboo.*

2. C. aurantium—*Kumla-neboo ;* and also, *narangee*—sweet orange. (Moluccas, Circars, Aurungabad, Khasia Mts. Here it has never fruited.)

3. C. Bergamia (C. acida, Roxburgh), under this, No. 3, he gives the following varieties :—

Bergamotte, or acid lime.
Pàti-neboo, common round lime.
Kàgujee-neboo, long small lime.
Gòra-neboo, thick-skinned, small, oval lime.
Chènee-gòra-neboo, China yellow-juiced lime.
Kamuralee-neboo, large, oval, smooth-skinned lime.
Rungpoor-neboo, round, smooth-skinned lime.
Taba-neboo, a large, globose, spongy-skinned lime.
Arabian lime, a large, thick-skinned sort, from Muscat.

4. C. Limetta, *Mita-neboo* (sweet lime).

5. C. Limonum, *Korna-neboo.*

6. C. Medica, *Bej-poora.*

7. C. Madurensis (Limonellus madurensis of Rumph.).

(NOTE.—This list introduces a new sort of confusion, by calling the C. acida of Roxburgh *C. Bergamia.* I have never seen or heard of the Bergamot citrus in India. Dr. Waring, in his "Pharmacopœia of India," may have taken this name from Voigt's list.) (*Vide* Appendix, No. 9.)

No. 56.

Gardeners' Chronicle, 30th January, 1886, p. 169.

A curious lemon.—" Exterior lemon-like, but all the interior compartments, except one, are in colour, flavour, and per-

fume those of the orange, the solitary exception having the attributes of a lemon. Those who are curious in such matters should consult our vol. for 1841 and 1842. The subject is also discussed briefly in Darwin's 'Domesticated Animals and Plants.' Various explanations have been offered, but, so far as we know, the only one based on actual experiment is that of Gallesio, who tells us that he impregnated an orange with the pollen of a lemon, and that the fruit borne on the mother tree (orange) had a raised stripe of peel upon it, like that of a lemon, both in colour and in taste. Supposing this statement to be accurate, we have thus an instance of the influence of the pollen, not on the germ only, but on the germ-case, or ovary, which is of course part of the mother plant."* (*Vide* pl. 259, for what Risso calls "Bigaradier Bicolor," and "Bigaradier Bizarrerie.")

No. 57.

Baron Hubner's "Through the British Empire," vol. ii., p. 271 (Australia).

"Enormous but almost tasteless oranges were served with the dessert. I am told that the trees which yield them, and which were planted by the convicts, have deteriorated from want of proper care."

No. 58.

From the "Penny Cyclopædia"—Citrus.

"In China there is an enormous variety of Citrus, with its lobes all separating into fingers of different shapes and sizes, whence its name of fingered citron. The Chinese esteem it very much, both for its rarity and for the grateful odour of its rind. They place the monstrous fruits on porcelain dishes, and have them in their apartments to fill the air with fragrance." (Called *Fo-show-kan*, or Buddha's hand.)

* It is doubtful whether the different varieties of Citrus are so easily mixed up as Gallesio's experiment would imply.

No. 59.

The following information was kindly given to me by Dr. Murray Thomson, Chemical Examiner to Government, Roorkee.

"The formula of cane sugar is $C_{12}\ H_{22}\ O_{11}$, and of Grape sugar $C_6\ H_{12}\ O_6\ H_2\ O$. The sugar of an unripe orange is chiefly grape sugar, but as the orange ripens, cane sugar appears, and when quite ripe the grape and cane sugar are in nearly equal quantity, viz. about 4·5 per cent of each.

"The formula for citric acid is $C_6\ H_8\ O_7$. Of course you will understand that this formula is based on the new atomic weights for carbon and oxygen—C_{12} and O_{16}. Oil of lemon, and oil of orange peel are chemically identical. They are hydro-carbons of the group $C_{10}\ H_{16}$."

No. 60.

Prof. Asa Gray, in his "Structural Botany," p. 288, para. 545, calls the edges of the carpels "leaf-margins," as in fig. 618 (caltha palustris) or marsh marigold, and the opposite suture he calls midrib.

In p. 260, para. 478, he says "carpel, or carpophyll denotes *pistil-leaves*, *i.e.* seed-bearing or fructiferous phylla (leaves). A carpel may be a pistil of itself, either the only one of a blossom, or one of several, or it may be a constituent of a more complex pistil. In either case, a carpel is the homologue of a leaf."

Para. 479.—"The ovules are peculiar structures normally arising as outgrowths from the margins of the leaf, or some part of them; sometimes from the whole, or a special portion of the upper or inner surface of the leaf."

At p. 299, para. 577, he says, "the Hesperidium (orange, lemon, lime) is the fleshy fruit of a free, many-celled ovary, with a leathery rind, and is a mere variety of the berry."*

* It would appear to me open to question, whether the Hesperidium ought to be classed with the berries.

No. 61.

Names which appear to be common to India and Japan —*Saturday Review*, April 30, 1887, p. 625.

"But the Japanese consume the yard-long roots of the *hasu* (Nelumbo nucifera) raw, boiled, baked, fried, or reduced to a flour, in soups. With the seeds they make cakes and pastry. *Hasu* is the vulgar, the pure Japanese name; the Sinico-Japanese, which is Buddhistic, and sacred, is *ren*, a corruption of the Chinese *lien*, the water-lily. . . . The Distylium racemosum (*isu*, or *yusu*), has long been used in Japan for wheel-cogs, and its ashes are extensively used by all the great native potteries, in their finest glaze, and in the famous celadon green, known as *seiji*."

In India they eat not only the *seeds* of the *Kèwul* (Nelumbium speciosum), or pink lotus, under the name of *Kèwul ghattà*, but also its long roots, under the name of *poo-rèn*. Half the latter word, and the Sinico-Japanese name *ren*, appear to mean the same thing. Can Buddhist missionaries have carried this name from one country to the other?

Then a sort of efflorescence scraped off certain soils in India is called *Sajji*. It is used for washing clothes, soap-making, and *glazing* pottery. Can this Indian word *Sajji* have any connection with the Japanese *Seiji?* If so, these two words, and perhaps many others, would appear to indicate intercourse, of a very ancient date, between the two countries. In the same way we find *Capas* (cotton) and *Kussumb* (safflower) and *Limoo* (citrus) common to both India and the Malay archipelago.

No. 62.

The following are speculative considerations, to account for there being frequently no juice vesicles on the sides of the pulp quarters or carpels, but only on the *circumference* side of the carpel. I have seen many instances, in which

the juice vesicles arose also from the *sides* of the carpel (see pl. 49, figs *b* and *h*), as ought to be the case, supposing they were homologous to the oil-cells of the leaves. In the latter, the oil-cells are disseminated all over the leaf, and not only near the midrib. It is nevertheless a fact that *generally* the juice-vesicles arise from that part of the carpel which goes to form the circumference of the *pulp-ball*. This circumstance I shall endeavour to explain in the following way:

The centre of the Hesperidium, or Citrus fruit is *fixed*, while its circumference moves outwards as the fruit grows and *expands*. We shall suppose that in the ovary, or when the hesperidium is quite young, the oil-cells of the carpel are on a *level* with its edges, or nearly so. It will be evident that, the edges of the carpel, forming the centre of the fruit, being fixed, some part must give way as the blade of the carpel is pushed outwards by the growth of the juice vesicles. Therefore those portions of the carpels, which have *stretched* gradually to adapt themselves to the filling of the vesicles with juice, will be those which now form the *sides* of the carpel, and which are usually *free* of vesicles. (See pl. 106, fig. *c*.)

This giving-way sometimes goes *beyond* mere *stretching*, and the parts are torn asunder by the bursting power of the expanding vesicles. This occurs generally in the *sùntara* and pummelo groups, which see.* In these cases, not only the whole carpel is separated from the central column, but often the edges of the carpel itself are torn asunder.

In pl. 61, fig. *b*, the central column remains isolated at A, while *all* the carpels have been torn away from it, and only keep up a communication by means of the radiating fibres. The carpels themselves are all closed.

Pl. 63, fig. *b*, shows the central column dragged to the one side by a closed carpel, while almost all the other carpels have not only receded from the centre, leaving there a hollow space, but are burst open with the points of their juice-vesicles projecting into the hollow centre.

Pl. 81 shows this bursting force in a more exaggerated manner, tearing the central column into several parts, A, A, A,

* One of the distinctive characters of the Portugal orange, and allied forms, is that, at maturity, the centre *is solid*.

and bulging out the circumference of the carpel also, on both sides of the mid-ribs, C, C, as well as tearing open some of the carpels.

Pl. 72, fig. *c*, shows an instance in which the attachment of the juice-vesicles was not only on the circumference portion of the carpel, but half way up its sides to B, B.

Pl. 106, fig. *c*, shows the usual attachment of the vesicles on the outer wall *c'*, while the two sides, which have gradually stretched like India-rubber membranes, are free of vesicles.

As will be seen in the *sùntara* group, one of the characters of this variety is a hollow centre, when the fruit reaches maturity.

In pls. 125, *e* and 126, *b*, is shown another effect of expansion. At a certain period of maturity, and after the pulp carpels have been dragged from the central column, their expansion is arrested, while that of the *skin or rind* goes on, so that the latter is also dragged away from the pulp carpels, leaving a hollow space between the pulp-ball and the skin. These oranges have a curious puffy feel, and the pulp-ball rattles within them.

No. 63.

In the British Museum, Assyrian Court, Nimroud, among the basso-relievos with cuneiform inscriptions, are Nos. 2, 21, 23, 24, 25, 29, 33, 34, 38 and 39. In these occur figures, making what have been called "mystic offerings." In all cases the figure has a basket in one hand, and in the other something like a large pine cone. This appears to be rather a *citron* than a fir-cone, as has been supposed. In one case the *mammilla* of the citron at the apex is clearly traced. The sculptor has shown the warts of the citron as uniform, much as he has shown the curls of the hair as a series of uniform nodules. These basso-relievos are put down as contemporary with the reign of Assur-na-sir-pal, about 880 B.C. Probably the Jews may have obtained the idea of using the citron in some of their religious ceremonies from the Assyrians during their captivity in Babylon. The citron appears to have been

of such a size as to have been easily grasped by the five fingers, such as those shown in pl. 151, *b*, and 167, *c*.

Then, in another place, a string of people are carrying presents to the king. Two are carrying a fruit like a pine-apple, as if something rare. The pine-apple, being an American plant, could not have been known in Assyria in those days. My supposition is that these two men are each carrying a *fingered citron* to the king as something rare and wonderful. The Phoenicians traded largely with India and China, and there would have been little difficulty in introducing the citron into Assyria at a very early date.*

No. 64.

The following is taken from the *Gardeners' Chronicle* of 8th October, 1887, p. 432.

Fruit Cultivation in San Francisco.

The British Vice-Consul says: "About 2,300 car-loads (23,000 tons) of oranges will be marketed from this district this season. The Orange Growers' Union so regulates shipments to the cities of the Eastern States, that an over-supply is not sent to any point. Los Angeles is the chief district of the orange industry.

"The cottony cushion scale, commonly called the white scale, is doing great damage to the orange groves. Many of the orchards have been cut down, and many others, now badly infected, will have to be treated in the same way. Nothing has as yet been discovered that will kill the pest without injuring the tree, and sufficiently inexpensive to admit of common use. Spraying the trees has been found ineffectual, owing to the fact that the liquid used did not reach every part of the tree. It is now stated that the owner of the oldest orchard in the district is about to patent

* For a further development of this idea, see an article of mine on the "Cone fruit of the Assyrian Monuments," in the *Babylonian and Oriental Record* for May, 1888, and subsequent numbers.

an apparatus for applying a gas to orange and other trees, which it is claimed will kill all scale-bugs without injuring the tree. A tent is constructed over the tree, and the gas is generated in the tent. Many are of opinion that the destruction worked by the white-scale bug and other pests is due to the fact that fertilizers not having been used, the soil is becoming impoverished. The fact that a 250 acre orange-grove at San Gabriel, which for some years has been fertilized, is free of scale-bugs and other pests, seems to indicate that the true remedy is good husbandry."

No. 65.

Trifacial Orange.

In Lindley's "Theory and Practice of Gardening," 2nd edition, p. 359, the following occurs :—

Rev. G. C. Renouard, writing to the *Gardeners' Chronicle* in 1841, when residing in Smyrna received a fruit which was said to be from an orange tree grafted on a lemon tree. "It was of the size of a large orange, with two or three patches of lemon neatly stuck on it, the colour, almost to the very edges of the different pieces, being distinctly that of the respective fruits ; and, on removing the rind, which, as in a common orange, was all of one piece, the portions beneath the lemon-coloured parts had not only a considerable degree of acidity, while the orange had its proper degree of sweetness, but they were separated from their sweet neighbours by a distinct membrane, which in some degree accounted for their difference in taste. The pulp was also, I believe, of a lighter hue. The patches of lemon were merely superficial, and of no great thickness. They made bumps, or irregular elevations, on the rind of the fruit."

The *Gardeners' Chronicle* of the 22nd September, 1855, p. 628, also mentions this so called *Trifacial* orange, and gives the mode of producing it artificially on the authority of Mr. St. John, who gives it on the authority of Boghas Joussuff,

of Alexandria. The latter appeared to have obtained this variety from his home in Smyrna. He says "It may be obtained by grafting the embryos of a lemon, a citron, and an orange in the following manner:—

"One of the three seeds is wholly skinned, so as to lay the embryo quite bare. Each of the other two is half-skinned, the skin being removed from one side only. This being done, the naked embryo (or naked *seed*, according to Lindley) is placed between the two others so as to be in contact with their skinned sides, and the whole are bound together with fine grass. They are then planted, and ultimately the *trifacial* fruit in question is borne." (! ?)

The mode of producing this variation appears to me an *oriental myth*, which may possibly have originated in the fact that *one* orange or lemon seed often contains *three or more buds*, and in germinating, produces three or more young plants in close contact. This is a well-known and common thing in citrus seeds.

Risso and Poiteau in their monograph of the citrus give a picture of the *Bigaradier Bizarrerie*, which I have reproduced in pl. 259, *c* and *d*. It is, in my opinion, no other than this so-called *trifacial orange*, but the theory of its origin is different.

"According to Pierre Nato, a physician of Florence, this 'Bizarria' occured thus: A seedling of the Séville was grafted (with what variety is not stated). Its strange characters were noticed in 1644. It was supposed that the graft failed (*manqué à la greffe*), and the gardener omitted to re-graft it. It threw up a shoot below the graft, which eventually produced this 'Bizarria.'" Other cases of "Bizarria" are quoted as having occurred elsewhere.

This "Bizarria" orange is said to have been subject to many variations. It flowered twice a year, some flowers were white, resulting in either Sévilles, or sweet oranges; more frequently, it had dull white flowers, resulting in mixed fruits, or flowers tinged purple, resulting in citrons.

Sometimes the citron influence was limited to the rind only; sometimes it affected the pulp also. Sometimes a tree which gave mixed fruits for some time, ended by giving only simple ones. A variety of "Bizarria" in Nice gave all the

shoots green, and all the flowers white, but some oranges were very sweet, and some very sour. He adds that this "Bizarria" can be multiplied by grafting, but it varies much. It is as inconstant as it is strange. Mr. Huard, "orangiste," of Paris, had one in 1818, which was forty years old, and on which were mixed fruits, and pure citrons. It was grafted on the citron, and would probably end by producing only the latter.

In pl. 52 of Risso and Poiteau, p. 79 (new edition by Du Breuil, 1872), this "*melangola Bizarria*" has two kinds of fruit —one is half orange-like and half citron-like, and the other with parts citron-like, alternating with parts which are lemon-like; some flowers are white, and some purple, but the *leaves* in the plate appear all of one kind, although in the text it is stated that they are often curled or deformed, with the petiole either naked or frequently winged, while the fruit is sometimes ordinary, and sometimes partly Sévilles; partly lemons or citrons; and the pulp in some very sweet, and in others acid and bitter.

I don't think I ever examined a citrus tree in India from which I could not gather leaves that resembled those of some other variety. Each tree would appear to reproduce among its own typical foliage, leaves, so to speak, of *former ancestors*. So that a diversity of *foliage* in the citrus is, I should say, a very common occurrence. I have given in the Atlas many forms taken from the same tree.

Darwin, in "Animals and Plants under Domestication," (2nd Edition, vol. i. p. 417), under the heading of *Graft hybrids*, says, "The famous *bizarria* orange offers a strictly parallel case to that of *Cytisus Adami*. The gardener, who in 1644, in Florence, raised this tree, declared that it was a seedling, which had been grafted, and after the graft had perished the stock sprouted, and produced the *bizarria*.* Gallesio, who carefully examined several living specimens, and compared them with the description given by the original describer, P. Nato, states that the tree produces, at the same time, leaves, flowers and fruit, identical with the bitter orange, and with the citron of Florence, and likewise compound

* I would respectfully ask—If the graft *perished*, how could it affect the stock, and give rise to a *graft-hybrid?*

fruit, with the two kinds either blended together, both externally and internally, or segregated in various ways. This tree can be propagated by cuttings, and retains its diversified characters.* The so-called *trifacial* orange of Alexandria and Smyrna resembles in its general nature the *bizarria*, and differs only in the orange being of the sweet kind; this and the citron are blended together in the same fruit, or are separately produced on the same tree; nothing is known of its origin. In regard to the 'Bizarria,' many authors believe that it is a graft-hybrid; Gallesio, on the other hand, thinks that it is an ordinary hybrid, with the habit of partially reverting by buds to the two parent forms; and we have seen that the species in this genus often cross spontaneously."

After stating the views of so many high authorities on the *bizarria* and *trifacial* oranges, it would appear little less than an impertinence on my part to offer any remarks. But, I think in the interest of Science I ought to state my views on this matter.

(*a*) I do not believe that the various species of citrus readily cross through their pollen. All my experiments to cross lemon flowers with orange pollen, proved failures, and Mr. Rivers has also recorded his opinion that they *do not cross.* From the permanency of character of the Séville, *khàtta*, and true lime in India, all three always propagated from *seed*, I would conclude that they do not intermix.

(*b*) With regard to citrons, oranges, and lemons being mixed in the "Bizarria" and *trifacial* oranges, I think perhaps that it is possible that *wartiness* may have been taken for *real* citron, because it was *not unlike it.* We do not really know what produces wartiness or smoothness, orange-colour or lemon-colour in certain varieties, but we do know that in the *khàtta* orange of India, a change from a dry season to a *wet* one will often induce *wartiness.* In the lemons, citron-like fruits are often produced in the rain-crop, and in other varieties the rain-crop is often more warty than the dry-weather crop. Therefore it is reasonable to infer that *wartiness* and thick skin, at all events, may be somehow connected with *luxuriance.* We know also that the different parts of the rind and pulp are nourished by *different* vessels, therefore

* It is, however, said to be subject to much variation in propagation.

we have only to suppose that in the cases of *apparently* mixed fruits, some of the vessels nourishing the warty parts may have been of *larger calibre* (a variation that might sometimes happen), and thus would give rise to *more luxuriance* and consequent *wartiness* in those strips. Then one cannot have much difficulty in concluding that a change in the rind might give rise to some change in the corresponding or adjacent carpels of the pulp, and so also induce a change in their colour and flavour, for we no more know what produces sweetness or sourness in the citrus, than we know what produces colour. No doubt these characters may be inherited, but the variations are infinite.

For my part, taking the view that both rind and pulp carpels are modifications of *branches*, I think that these mixtures in one fruit of the citrus may possibly be explained by simple *bud-variation*, without any direct influence of either pollen or graft, whatever the *cause* of this bud variation may be.

No. 66.

It appears that in India the word *creese* means a weapon, and therefore may be the same as *krissen* of the Malays, which Rumphius mentions in his chapters on the Citrus. The *Saturday Review* of 20th August, 1887, in a review of the Royal Jubilee Exhibition at Liverpool, says, with regard to the collection of arms, that "it ranges from the tiny Indian 'creese' to the 100-ton gun." This word *creese* appears to be another, which is common to both India and the Malay archipelago.

No. 67.

The following catalogue was courteously brought to my notice by Dr. Trimen, Director of the Royal Botanic Garden of Peradeniya, Ceylon.

"Catalogus Plantarum in Horto Botanico Bogoriensi cultarum alter" (Batavia 1844), by Justus Karel Hasskarl.

I have extracted from it the following list of citrus plants, p. 216:—

No. 952.—*Papeda*, Hsskl., differs from citrus in having a plane four-toothed calyx, with four petals, twenty-four stamens, with their filaments all free. *Papeda Rumphii*, Hsskl. (Lemon Papeda, Rmph. Amb. II. 104, t. 27), *Djerock poerroet* (Frutex, arbor).

Petioles large winged, leaves ovate obtuse crenate, with transparent dots; flowers in terminal racemes; fruit sub-globose, thick skinned, warty; pulp greenish, bitter, and very acid. The petals externally are of a dull rose colour. The flowers are among the smallest.

No. 953.—*Citrus*, L. Endl. Gen. 5514. *Citrus ovata* (Hsskl.), *Djeroek tanjoeng boerrah* (Arbor).

Petioles almost naked, leaves ovate, rather acute, crenate-serrate; flowers sub-corymbose, with thirty stamens, the terminal corymbs few-flowered; fruit sub-oviform, skin rather thick, yellowish-green; pulp pale, juice acid; petals totally white.

Citrus amara, Hsskl. *Djeroek post*, or *Dj. Liemoh gedeh* (Arbor).

Petioles almost naked, the larger leaves elliptic, or ovate-oblong, obtuse, sometimes retuse, with large crenations; flowers . . . .; fruit globose, golden yellow, thin-skinned; pulp yellowish-green, juice bitter-acid.

Citrus crassa, Hsskl. (or C. Javanica, Bl. Bijdr. 140?) *Djeroek honjeh gedeh* (Arbor).

Petioles almost naked, the larger leaves ovate or obovate, oblong, obtuse or retuse, crenulate-serrate; flowers with forty stamens, petals whitish, oblong; fruit citrine, oblong, with a very thick skin; pulp small, juice acid.

Citrus limonellus, Hsskl. (an Amlt?), almost spineless, petioles almost wingless, leaves ovate, or ovate-oblong, obtuse crenate; flowers almost solitary, fourteen to twenty stamens; fruit globose, thin-skinned, shining yellow, and adherent; pulp pleasant and very acid; leaves, flowers, and fruit among the smallest. *Var. a. Oxycarpa*, Hsskl. *Djeroek niepies*, or *Dj. tiepies* (that is small). Limonellus, Rumph. Amb. II. 107, t. 29.

Fruit mammillate acute; leaves rather acute, petioles

slightly winged. *Var. b. Amblycarpa*, Hsskl. *Djeroek liemoh* (Arbor).

Fruit with a depressed extremity; leaves rather obtuse, petioles almost naked.

Citrus nobilis, Lour.

Petioles almost naked, or slightly winged; leaves ovate oblong, or elliptic, and rather obtuse, serrato-crenate; flowers with twenty stamens; fruit depressed-globose, skin very thick and easily separated, pulp golden-yellow, juice very abundant and very pleasant—fruitful.

Var. a. chrysocarpa, Hsskl. *Djeroek djoplok.*

Leaves narrowed at the base and apex, rather obtuse or emarginate, petioles generally almost naked; skin of fruit greenish golden-yellow.

Var. b. melaaocarpa, Hsskl. *Djeroek hiedung* (meaning black).

Leaves with an obtuse base, often with a bifid or emarginate apex; mature fruit dark green. (Probably the green orange of Ceylon—E. B.)

Var. c. microcarpa, Hsskl. *Djeroek djepoen leutiek.*

Leaves with an acute base, and apex either acute, obtuse, or rounded; petioles almost naked; mature fruit smaller by half, skin greenish-yellow. (*Citrus japonicus*, Thub. Sbld. Zee. Fl. Jap. I. 35, t. 15.)

Var. a., with globose fruit l. c. f. II. *Kinkan Japon* (small tree).

Var. b., with elliptic fruit, l. c. f. III., *Tookinkan Japon* (small tree).

Citrus pyriformis, Hsskl. *Djeroek pandjang* (meaning long). Petioles slightly winged, leaves elliptic or ovate-elliptic, acute at both ends, or rather obtuse, edges curved backwards, crenate; flowers with twenty-four to thirty stamens; fruit pyriform (or obversely oviform, with attenuated base); skin rather thick, pulp citrine and very pleasant; petals white on both sides; branches with large or minute spines.

Citrus aurantium, Risso, Dc. Prdr. I., 539. Bl. Bijdr. 140,

Djeroek djepoen leutiek (japonica minor), that is *Japanese small orange.* Petioles obcordate; leaves oval or ovate, apex rounded or rather acute, crenulate, more than six times larger than the petioles; all the axils armed with a very long and round spine (2 poll); flowers . . . .; fruit globose, large, citrine, skin rather thick, pulp pale; juice very agreeable, sweet and copious.

Citrus decumana, L. Dc. Prdr. I. 539, Bl. Bijdr. 140, *Djeroek balie.* There are many varieties not yet sufficiently known to me. (*a*) *Djeroek miskien,* with a large depressed fruit; (*b*) *Djeroek sigadogan,* with a smaller and less depressed fruit and thin skin; (*c*) *Djeroek pandan,* with a thick skin; (*d*) *Djeroek matjang,* two varieties of this occur, (*a*) *Rhodocarpa,* Hsskl. (red pulp); (*b*) *Leucocarpa,* Hsskl. (pale pulp).

Citrus grandis, Hsskl. (*a*) *Sphœrocarpa,* Hsskl. *Djeroek Assam boelet* (meaning acid globose).

Petioles linear short, leaves large oval, rather acute at both ends, or retuse crenate; flowers . . . .; fruit large, globose golden-yellow, skin thick, pulp greenish-yellow, juice acid; seeds rose-coloured.

(*b*) *Oblonga,* Hsskl. *Djeroek Assam pandjang* (meaning long). Fruit oblong, with the rudiment of the style acute and persistent, mammillate.

(*c*) *Obversa,* Hsskl. *Djeroek balik.*

Petioles (in the same branch) sometimes obcordate, sometimes linear and scarcely winged, leaves oval, obovate, or elliptic, base rounded, more or less retuse, with margins slightly recurved and crenate; flowers racemose, large, with thirty-six stamens; fruit oblong, obtuse, with the base slightly attenuated; skin of an orangy colour, warty, juice acid and pulp red.

Citrus Papaya, Hsskl. *Djeroek Papaya.*

Petioles almost naked, leaves oblong, or elliptic oblong, rather membranaceous, with an acute or rounded base, apex acute or sometimes subretuse, margin cartilaginous, recurved, crenate; spines axillary, straight, and

short; fruit oblong mammillate, of the shape of *Carica Papaya* (Papita of India, E. B.); skin thin, yellowish-green, pulp white, juice acid.

(NOTE.—I don't quite see what has been gained by giving all these kinds of citrus Latin names. They do not appear to diminish, but rather to increase the confusion.—E. B.)

No. 68.

Regarding Chinese terms of oranges, &c., I asked Prof. Dr. T. de Lacouperie, the Director of the Babylonian and Oriental Record, for some help. He very courteously replied as follows:—

"In Chinese, *kinkii* (in the south *kamkwat*), or gold orange, is the 'Citrus Japonica.'

"*Tcheng* is the Coolie orange; *Kan* (in the south *kom*), is the Coolie mandarin orange (Citrus nobilis).

"The Citrus decumana, in Chinese is called *yu shu*, which name, being extremely old, is most probably the antecedent of the *usse, ussi*, and *usoh* you mention."

NOTE.—In the word *cheng* we probably have the first half of the name *Sùntara*, or *Sengtara*. The antiquity of *yu shu*, the name for pummelo, confirms my suspicion that this huge citrus originated in China, and that this name was probably the parent of the generic *usoh* in the *Khasia* hills, and *usse*, or *ussi*, in the Malay archipelago.

Sadàphal, ever-fruiting ; applied to a kind of citrus.
Seer, weight denoting 2 lbs.
Serrations, teeth on the edges of leaves.
Shouk-potè, Burmese term for *Lima* (c. hystrix).
Shutrunj, variety of citron in Bengal.
Sìderun, variety of citron in Ceylon.
" Sinense," of China.
Sou, in Sylhet means 3,000.
Spores, seeds of ferns and fungi.
Stamen and Stamina, male or pollen-bearing organs of flowers.
Sùngtara
Sungtereh
Samtereh
Sintra
Suntowrea
Simtra
Santola } variations of the name *Sùntara.*
Sùntara, name of a loose-skinned Indian orange.
Superfœtation, obsolete term meant to denote impregnation many times over.
Surkh, Hind. for red.
Suture, the line of contact or union of two carpels.
Synanthy, adhesion of flowers.
Syncarpy, growing together of carpels.

Tarai, damp district at the foot of the Himalayas.
Tehsil, sub-collectorate of revenue.
Thàla, saucer-like ridge round a tree, for purposes of irrigation.
Tòla, a rupee's weight (about a two-shilling piece).
Tomentose, downy.
Toronja, pronounced Toronkha, Spanish for citron.
Trifacial, many-sided orange (mixed orange and citron).
Tursh, sour.
Turunj, name of a citron.

Utruj, said to be Arabic for citron.

Yâd, Hind. for " remember."

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